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El Yunque National Forest

Final Environmental Impact Statement

for the Revised Land Management Plan

Forest Service | Region 8 | El Yunque National Forest | R8-MB 152 B | August 2018

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Final Environmental Impact Statement for the Revised Land Management Plan

Rio Grande, Puerto Rico

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Abstract: Three alternatives for revision of the 1997 El Yunque National Forest Revised Land and Resource Management Plan (Forest Plan) are described, compared, and analyzed in detail in this final Environmental Impact Statement (EIS). Alternative 1 represents no change from the current Forest Plan. Alternative 2 is the proposed action for the final revised Forest Plan and the alternative preferred by the Forest Service. Alternative 3 is a variation of alternative 2.

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List of Acronyms

CCC	Civil Conservation Corps
CIRMA	Community Interface Resource Management Area
DEIS	Draft Environmental Impact Statement
ESE	Ecological Sustainability Evaluation
FEIS	Final Environmental Impact Statement
GA	Geographic Area
MA	Management Area
MCF	Million Cubic Feet
NEPA	National Environmental Policy Act
NF	National Forest
NFMA	National Forest Management Act
NFS	National Forest System
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NVC	National Vegetation Classification
RNA	Research Natural Area
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
SCC	Species of conservation concern
T&E	Threatened and Endangered
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCF	Watershed Condition Framework

Summary

This final environmental impact statement (FEIS), prepared by the U.S. Forest Service, describes and analyzes in detail the three alternatives for managing the land and resources of El Yunque National Forest. It describes the affected environment and discloses environmental effects of the alternatives. The planning record is available on our public website at: http://www.fs.usda.gov/main/elyunque/landmanagement/planning.

Proposed Action

El Yunque National Forest proposes to revise the 1997 Land and Resource Management Plan for the Caribbean National Forest and Luquillo Experimental Forest, as amended (hereafter referred to as the 1997 Forest Plan or 1997 Plan), in compliance with the 2012 planning rule (36 CFR 219.17(3)(b)(1)). The proposed action addresses the planning, collaborative, sustainability, social, economic, and ecological needs that have been identified for the final revised Plan. The Forest Plan guides all-natural resource management activities on El Yunque National Forest to meet the objectives of Federal law, regulations, and policy. The area affected by the proposal includes about 29,000 acres of El Yunque National Forest (see map 1-1).

Purpose and Need for Action

The need to revise the current Forest Plan includes the following:

- The existing Forest Plan is more than 20 years old and has been amended three times.
- There is a need to meet the legal requirements of the National Forest Management Act (NFMA) and the current planning regulations, 36 CFR 219.
- Since the Forest Plan was approved in March 1997, there have been changes in economic, social, and ecological conditions, new policies and priorities, and new information based on monitoring and scientific research; there is a need for these changes to be reflected in the Plan.
- Extensive public and employee involvement, along with science-based evaluations, have helped to further identify the areas of the existing Forest Plan that need to be changed.
- From 2012 through 2016, El Yunque National Forest developed the Plan Assessment (USDA Forest Service 2014), the Need for Change (USDA Forest Service 2014, 2015) and the Proposed Management Strategies (USDA Forest Service 2015, 2016). The purpose of these documents was to assess new information, changes in technology, the 2012 Planning Rule, land uses, and to identify what did and did not work well in the 1997 Forest Plan. These assessments and public comments and recommendations were summarized into five areas where a change from current Forest Plan direction is needed:
  1. Incorporate collaborative adaptive management at the Plan and site-specific levels.
  2. Define a new recreation, access, and tourism system.
  3. Promote a stronger regional identity in and around the Forest using an “all-lands” policy.
  4. Increase regional environmental literacy and educating local communities.
  5. Provide for healthy ecosystems.

Public Involvement

The notice of intent (NOI) to prepare an EIS was published in the *Federal Register* on September 18, 2014 (79 FR, pages 56050-56054). The legal notice was published in the two newspapers of record, *Nuevo Dia* and *San Juan Daily Star* on September 14, 2015. The public was asked to comment on the proposed action by November 3, 2014. From 2014 to 2015, approximately 28 outreach activities and meetings were hosted (see planning record or appendix A). Planning outreach activities included meetings with different communities and the public in general in locations that were accessible to the different municipalities located to the north, east and southwest of the Forest. Meetings were held with stakeholders including recreation outfitters, protected area land managers, municipality planners, the scientific and academic community, and the Center for Landscape Conservation (CCP for its acronym in Spanish). The meetings were designed to describe and discuss the existing forest and resource conditions being used to develop the proposed action, and to collect information and comments from the public on land use for the Forest, and to consider suggestions for new alternatives for managing the Forest. Information and recommendations from these planning outreach activities were used to develop the proposed action for the final revised Plan. The proposed action was shared with the public through a series of community meetings and interest group meetings to validate its content. The public outreach process spanned almost 2 years and the complete public involvement process can be found in the planning record.

Concurrent with the release of the draft EIS, a notice of availability (NOA), published in the *Federal Register* initiated the formal 90-day comment period on the draft EIS and proposed Forest Plan as required by Forest Service NFMA regulations at 36 CFR 219. Only those individuals and entities who submitted substantive formal comments related to this plan revision are eligible to file an objection (36 Code of Federal Regulations (CFR) 219.53(a)).

Comments made by the public on El Yunque National Forest DEIS and Proposed Forest Plan addressed a wide range of concerns but were largely focused on recreation opportunities and wildlife. A total of 14 comment letters were received from the public, agencies, and public interest groups.

Issues

Significant issues are those directly or indirectly caused by implementing the proposed action. These issues drive the range of alternatives and effects analysis. Alternatives were developed around those issues that involved unresolved conflicts concerning alternative uses of available resources. See the "Alternatives" section in chapter 2. No areas of scientific controversy were identified.

Significant Issues

Based on comments and analysis from Forest Service personnel, the public, other agencies and nongovernmental organizations, the following significant issues were identified:

1. What is the best approach to provide sustainable recreation opportunities that minimize impacts to the forest while meeting current and future needs and demands of users and surrounding communities?
2. What is the best approach to respond to the potential effects of climate change on Forest resources and ecosystem services?
3. How, where, and to what extent can the Forest provide opportunities that contribute to and enhance social and economic conditions in the region?

Alternatives

Three alternatives are described, compared, and analyzed in detail.

Alternative 1

The "no action" alternative would continue management under the 1997 Revised Land and Resource Management Plan for the Caribbean National Forest and Luquillo Experimental Forest, as amended. The alternative retains the 1997 Forest Plan goals and objectives, standards and guidelines and nine management area prescriptions (as amended). Management would continue to be focused on four forest types and would retain direction for managing species as management indicator species. Recreation would continue to be promoted in functional wetlands that are above 600 meters in elevation. One area suitable for wilderness designation (the Baño de Oro Inventoried Roadless area) would continue to be managed as part of the proposed expansion to the Baño de Oro Research Natural Area, which would continue to provide for long-term watershed research and studies and which is also a National Natural Landmark. Three rivers would remain eligible for wild and scenic river designation. This alternative does not address sustainable forest recreation or include management areas that would improve social and economic development at a broader landscape scale.

Alternative 2

Alternative 2 is the proposed action and the preferred alternative for the final revised Forest Plan. It addresses public desire to access the forest for recreation, but recognizes carrying capacities and the need to maintain sufficient infrastructure to support visitation. It addresses climate change by shifting recreational opportunities at the lower elevations of the Forest, which are better suited for recreational use. Alternative 2 would:

- Propose a new planning system based on ecological, social, and economic sustainability.
- Recognize the need to protect and restore the functional wetlands that occur over 600 meters in elevation and increase forest types from 4 to 15 to reflect the new vegetation classification system and the Forest's most recent findings.
- Promote recreation sustainability, and address increased demands and needs by promoting recreation at lower elevations in a setting closer to local communities.
- Introduce plan components for environmental education, collaboration, and ecosystem services.
- Establish nine management areas including a new scenic byway corridor for PR 186.
- Establish three geographic areas (El Norte, El Este and El Oeste and Sur) to increase community interactions and an "all-lands" approach to planning.
- Establish a Community Interface Resource Management Area (CIRMA).
- Recommend expansion of the Baño de Oro Research Natural Area to 6,441 acres, for the purpose of research and long-term watershed studies. Remove direction for managing species as management indicator species and replace it with species of conservation concern.
- Provide additional management direction for priority watersheds using the national watershed condition framework.

Alternative 2 would retain existing Forest Plan direction for research on wilderness and wild and scenic rivers on the Forest.

Alternative 3

Alternative 3 was developed to respond to concerns related to sustainability. It would reduce the number of maintained trail miles. This alternative would expand wilderness, and would not create a scenic byway management area. This alternative is based on alternative 2 with the following changes:

- Recommend designation of the Baño de Oro Research Natural Area as wilderness.
- Provide additional plan components to address invasive species management in areas of road rights-of-way, recreation areas, and threatened and endangered habitats.
- Address some sustainable recreation concerns by reducing the trail system to a level that can be maintained.
- Create two geographic areas, North and South, to connect with communities on both sides of the Forest.
- Exclude the scenic byway management area for PR 186, due to the amount of use this would produce on the western side of the Forest.

Alternatives Considered but Eliminated from Detailed Study

Public comments received in response to the proposed action provided suggestions for alternative methods of achieving the purpose and need. Some of these alternatives may have been outside the scope of what can be included in the final, revised El Yunque Forest Plan, duplicative of the alternatives considered in detail or determined to be components that would cause unnecessary environmental harm. Three alternatives were considered, but dismissed from detailed consideration for reasons summarized below.

Custodial (no recreation management, special uses, or research management)

This alternative was not considered in detail because it does not meet law or policy requirements to provide multiple uses. This alternative would not comply with the dual designation of El Yunque National Forest as also the Luquillo Experimental Forest.

Intensive recovery of the Puerto Rican parrot

This alternative was not considered in detail because in the 1997 Forest Plan it was accepted, but not scientifically supported, that El Yunque was potentially prime habitat that would support a viable parrot population. Since then, interagency recovery research has found El Yunque National Forest is not optimal habitat for the Puerto Rican parrot, and is focusing recovery efforts in better habitats to the west of the Forest (White et al. 2014). Therefore, the new plan will keep Puerto Rican parrot recovery as an important management objective and continue to be in compliance with all relevant Federal and State land management regulations, but will not continue to manage the Forest as habitat vital to the recovery of the species.

Recommending designation of all eligible wild and scenic rivers

This alternative was not considered in detail for the following reasons:

- There is little public interest in wild and scenic river designation for six rivers;
- Additional areas would increase management complexity; and,
- People would still like to have access to these areas.

Summary of Effects and Comparison of Alternatives

Ecological Sustainability

All native ecosystems and native species, including at-risk species, would be protected in all alternatives. Each alternative includes the Forest Plan components for ecosystem diversity necessary to provide the ecological conditions to conserve threatened and endangered species. Alternative 1 emphasizes the acquisition and conservation of key land units connected to the Forest, addressing some interests in landscape connectivity. However, Forest Plan (proposed action) components that promote landscape connectivity and an "all-lands" approach to Forest management and conservation is a key in alternative 2 through the development of a new Community Interface Resource Management Area (CIRMA) and the identification of three geographic areas. The geographic areas target conservation initiatives that may be developed, including stream corridors and riparian zones. The new management and geographic areas provide plan components that connect the Forest to other public lands and protected areas. In alternative 2 these areas provide direction that would identify and protect critical connections and developments at the sub-regional level.

Soil, water and air quality would be maintained in all alternatives. Alternative 2 would include watershed priority management to improve watershed conditions in specific areas.

The changing climate is expected to create impacts, such as sea-level rise, increases in temperature, and greater variation in precipitation. Management direction in all alternatives focuses on creating diverse, functioning ecosystems that are resilient to these changes. The final revised plan (alternative 2) proposes aligning management areas, enhancing landscape connectivity, and maintaining wetland conditions to promote amphibian habitat.

The Forest Plan components for the experimental forest designation would be retained in all alternatives. Alternative 2 would include a management area designated for ongoing, long-term research (Bisley, El Verde, Baño de Oro) and emphasize Forest monitoring as a fundamental element of adaptive management.

Social and Economic Sustainability

In all alternatives the Forest would continue to provide open space and natural settings, as well as an array of goods and services that are important to nearby residents and various communities of interest. However, alternative 1 (current plan) does not include components oriented toward sustainable recreation opportunities and settings. In the long term, this direction would lead to adverse impacts from increased, unsustainable recreation across the Forest. Alternative 1 does not address opportunities for increasing environmental education and literacy at a regional level or with specific groups (e.g., schools, university groups); nor does it provide direction for using research and knowledge development within the context of adaptive forest management. Alternative 2 and 3 are designed to address these needs.

Alternative 2 (proposed action) differs from alternative 1 and alternative 3 in its development of a recreation corridor along PR Road 191, a scenic byway along PR Road 186, and a community interface resource management area (CIRMA) where multiple sustainable uses, including passive and active recreation can be developed and carried out in collaboration with nearby communities and governments. Under the final revised plan direction, recreation activities would be dispersed to lower elevations of the Forest, alleviating some of the existing pressure of intense use along PR 191, and ultimately allowing for more sustainable levels of recreation throughout the Forest and satisfying a broader range of recreation values and interests. Alternative 3 would eliminate recreation trails that may not be sustainably maintained.

In alternative 1, one area suitable for wilderness designation (the Baño de Oro Inventoried Roadless Area) would continue to be managed as part of the proposed expansion to the Baño de Oro Research Natural Area, providing for long-term watershed research and studies. Three rivers would remain eligible for wild and scenic river designation. Alternative 2 does not recommend any areas for wilderness designation. The final revised plan would expand (increase the acreage) the Baño de Oro Research Natural Area to include all mature forest on the eastern side of the Forest. No new wild and scenic river recommendations would be provided. Alternative 3 differs from alternative 1 and 2 by recommending the designation of a new wilderness area in the expanded Baño de Oro Research Natural Area. If designated as wilderness, recreation and non-market services interests and values would be served, but research and education stakeholders, particularly manipulative research interests and needs, are likely to be impacted (as these uses would be prohibited under wilderness designation).

While each alternative has the potential to affect local businesses and industrial sectors, the contribution of El Yunque National Forest to the local economy, and the relative differences among the alternatives, would not be large enough to cause measurable changes to local economic diversity (e.g., the number of economic sectors) or economic dependency (i.e., a limited number of industries dominate the local economy). However, alternative 2 best promotes existing and new economic opportunities tied to the Forest, particularly through the development or demonstration of multiple, sustainable uses in the CIRMA and nearby communities. The final revised plan (alternative 2) includes management strategies that support community collaboration and development, and ultimately lead not only to the creation of indirect and induced jobs, but also enhanced stewardship of the Forest and its goods and services.

Overall, shifts in the local economy are likely to occur over the next 20 years or so, though not as a direct result of actions implemented under any alternative management scenario. Under all proposed alternatives, payments to the Commonwealth and municipalities would continue to help fund schools, roads, and public services; and ultimately contribute to the sustainability and health of local communities, particularly by supporting important amenities and services provided by local and Commonwealth governments.

Comparison of Alternatives

Tables at the end of chapter 2, beginning with table 2-3, compare the alternatives by a variety of measures. Table 2-3 qualitatively compares the alternatives by the significant issues identified during the public participation process. Table 2-4 compares the alternatives by management area allocation acres. Table 2-5 compares timber suitability acres and timber volume by alternative. Table 2-6 compares recommended wilderness acres by alternative.

Table S-1. Comparison of alternatives by significant issues

Significant Issues	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3
Issue 1. What is the best way to provide sustainable recreation opportunities that minimize impacts to the Forest while meeting current and future needs and demands?	The 1997 Plan does not include plan components that address sustainable recreation. The plan increases the recreational opportunity; therefore, impacts will be expected to increase. This alternative helps us to meet current and future demands regardless of impacts. The alternative does not contemplate the impacts of recreation site development.	This alternative provides for sustainable recreation by including plan components that consider wetlands, community interface areas, limits on capacity and funding. This alternative addresses current conditions of cultural resources, the need to protect sensitive areas at higher elevations, disperse the recreational opportunity away from PR Road 191 in order to decrease crowding and improve setting.	This alternative provides for sustainable recreation. This alternative reduces the recreational opportunity and setting by reducing the trail system. The alternative responds to the issue by reducing capability to meet demands.
Issue 2. What is the best approach to respond to the potential effects of climate change on the Forest resources, ecosystem services and others?	This alternative does not respond to the issue. There are no specific plan components in response to climate change.	This alternative contains plan components that focus on climate change.	This alternative responds to the issue by promoting species management on threatened and endangered habitats and invasive species. Provides a stronger response to climate change.
Issue 3. How, where, and to what extent can the Forest provide opportunities that contribute to/enhance social and economic conditions in the region?	The Forest's main contributions to the social and economic condition would continue to include recreation, water and biodiversity. This alternative responds to the issue by maximizing outputs of recreational opportunities, providing for water, timber products and research within the Forest.	This alternative responds to the issue by introducing recreational sustainability, establishing plan components for recreation along Road 191 and shifting recreation opportunities to lower elevations, establishing a new access, recreation and tourism strategy based on collaboration and community partnerships. It best promotes existing and new economic opportunities tied to the Forest, particularly through the development or demonstration of multiple, sustainable uses in the Community Interface Resource Management Area and nearby communities.	This alternative responds to the issue by reducing recreational opportunity within National Forest System lands while promoting recreational opportunities off National Forest System lands.

Chapter 1. Purpose of and Need for Action

This final EIS and final revised Forest Plan have been prepared in accordance with Title 36 Code of Federal Regulations, Part 219 – National Forest System Land Management Planning (2012 planning regulations), the National Forest Management Act of 1976 (NFMA), the National Environmental Policy Act (NEPA) of 1969 and other relevant Federal and state laws and regulations. This final EIS discloses the direct, indirect and cumulative environmental impacts that would result from the proposed action and alternatives. This document is organized into the following sections.

Chapter 1. Purpose and Need for Action: This chapter includes information on the history of the project proposal, the purpose and need for the project and the Forest Service's proposal for achieving the purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.

Chapter 2. Alternatives, including the Proposed Action: This chapter provides a more detailed description of the Forest Service's proposed action as well as alternative methods for achieving the stated purpose. These alternatives are based on significant issues raised by the public and other agencies. Finally, this section provides summary tables of the environmental consequences associated with each alternative.

Chapter 3. Affected Environmental and Environmental Consequences: This chapter describes the environmental effects of implementing the proposed action and other alternatives. The analysis is organized by themes developed from public involvement. Major themes include: Ecological sustainability, social and economic sustainability, and resource integration.

Chapter 4. Consultation and Coordination: This chapter provides a list of preparers and agencies consulted during the development of the final EIS.

Appendices: The appendices provide more detailed information to support the analyses presented in the final EIS.

References and Literature Cited: This section lists reference documents used in the preparation of this plan.

Note: The final Forest Plan for El Yunque National Forest is a separate accompanying document. Additional documentation, including more detailed analyses of project area resources, may be found in the planning project record located at El Yunque National Forest Supervisor's Office. Key analysis documents can be found online: http://www.fs.usda.gov/main/elyunque/landmanagement/planning.

Map 1-1. El Yunque National Forest and vicinity

1.1 Location

El Yunque National Forest is the only tropical forest administered by the USDA Forest Service with a Forest supervisor and staff. The Forest has dual designation as an experimental forest (the Luquillo Experimental Forest).

Offices are located at Headquarters and El Portal Visitor Center on PR Route 191, kilometer 4.4, south of Palmer, Río Grande.

The Forest is located in the rugged Sierra de Luquillo Mountains, 25 miles southeast of San Juan, Puerto Rico. The Luquillo Mountains raise abruptly from sea level at Las Cabezas de San Juan on the northeastern tip of Puerto Rico to 1,074 meters in elevation at El Toro Peak. The Forest is approximately 29,000 acres (map 1-1). Elevation ranges from about 330 to 3,533 feet above sea level. Topography is rugged, with 24 percent of the Forest exhibiting 60 percent slope or steeper.

There are three geographic scales considered in this document: municipal, regional, and Island-wide. In Puerto Rico, a municipality is the smallest division of administrative and electoral government, similar to a county in the United States. The Forest is surrounded by nine municipalities in Eastern Puerto Rico: Canóvanas, Ceiba, Fajardo, Juncos, Las Piedras, Luquillo, Naguabo, Rio Grande and Humacao. These comprise more than 220,000 acres (347 square miles), which is about 10 percent of the Island's total area. Stretching over 29,000 acres, the National Forest covers about 15 percent of the total El Yunque Region. Of the municipalities surrounding El Yunque, Rio Grande is the largest in terms of area and also encompasses the largest area of National Forest land within its borders (20.26 square miles; 33.2 percent of its total land base). At the other end of the spectrum, Juncos is the smallest of the region's municipalities and encompasses the smallest area of National Forest System land (0.03 square miles, 0.1 percent of municipality).

1.2 Background

In 1997, the Forest Service developed a management plan that considered several issues and management needs. The 1997 management concept focused on a strong conservation approach. The planning strategy was to obtain a formal designation for the research natural areas, wild and scenic rivers, and wilderness. Finally, the plan addressed the utilization of water, wildlife, and research. The social needs were addressed through recreation and access initiatives.

The 1997 Plan considered the following issues:

1. Demonstrating timber production while assuring compatibility with a diversity of other Forest values.
2. Recommending areas for congressional designation as wilderness.
3. Recommending areas for congressional designation as wild, scenic or recreational rivers.
4. Protecting the mature forest.
5. Providing recreation opportunities while protecting the ecological values of the Forest.
6. Protecting wildlife while conducting other forest management activities.
7. Providing and protecting the Forest's water quantity and quality.
8. Providing and managing appropriate Forest access.
9. Meeting the needs of tropical forestry research while protecting the Forest's environmental values.

In 2007, a comprehensive evaluation report (CER) of the Plan was conducted. The purpose was to review the accomplishments of the plan and recommend changes. The comprehensive evaluation report's findings were:

1. *Land ownership:* Desired conditions should state priorities clearly and emphasize the need for more partnerships.
2. *Access Management:* Desired conditions should address greenhouse gas emissions caused by vehicle traffic.
3. *Facilities:* Desired conditions should be updated to address minimizing construction practices that contribute to greenhouse gas emissions.
4. *Socioeconomics:* Monitoring should be developed to gather data on social and economic trends for future evaluations.
5. *Special Uses and Communication Sites:* Public-private partnerships may need to be increased. Climate change, sustainability, and green technology standards and guidelines should be incorporated into permit uses.
6. *Recreation:* Standards and guidelines for camping should be updated.
7. *Scenery:* Standards and guidelines should be updated using new Scenery Management System.
8. *Heritage:* Desired conditions should provide emphasis on preserving and stabilizing heritage resources. Management direction should be updated to reflect current science.
9. *Minerals:* Desired conditions should be updated to reflect management direction for minerals.
10. *Vegetative Communities:* Desired condition and management direction should be updated to reflect current science.
11. *Fish and Wildlife:* Desired conditions should be updated to provide protection for species that may be affected by climate change.
12. *Air:* Management direction should be updated to reflect current science.
13. *Research:* Desired conditions should be updated to address disclosure of research activities and promote high priority research topics for study.
14. *Timber Demonstration:* Management direction should be updated to reflect current science.

The 2014 and 2015 Need for Change document (USDA Forest Service 2014, 2015) identified the forest plan components that need to be updated or added in this forest planning process. Furthermore, congressional designation of El Toro Wilderness and the Rio Mameyes, Rio de la Mina and Rio Icacos Wild and Scenic Rivers represented quite an achievement in land allocation. The significant number of recommendations from the comprehensive evaluation report, progress made on six of the nine issues considered in the 1997 Plan, and the assessment findings created the need to change the plan.

In 2012, the Forest Service established an interdisciplinary team (ID team) to lead the plan revision process. In the fall of that same year, the ID team assessed what had been accomplished, new information, changes in technology, new Forest Service Planning Rule and land uses, as well as what did and did not work well in the 1997 Forest Plan. The ID team also developed the following three important documents:

- **El Yunque National Forest Plan Assessment (2014).** This document consists of ID team specialists' reports and supporting supplemental reports. Several topics are covered including: wildlife habitats, at-risk species, natural disturbances, recreation opportunities, etc. At the beginning of each subsection are findings that highlight accomplishments, changed conditions, challenges, opportunities, data gaps and research needs. The assessment feeds into the affected environment in chapter 3 of this final EIS.

- **El Yunque National Forest Need for Change (2014–2015).** This document focuses on management direction that "needs to change" in the current Forest Plan. Using the findings in the assessment, the ID team developed "need for change" statements. These statements framed the scope of the proposed action.
- **El Yunque National Forest Plan Revision: Proposed Management Strategies (2015–2016).** This document addresses need for change statements in El Yunque National Forest Need for Change. Management strategies describe, in broad terms, how the agency would achieve desired conditions over time while considering priorities, such as program direction, budget trends, past program accomplishments and partnership opportunities. In some instances, these proposed management approaches are applied to areas that are similar in some respect across El Yunque National Forest and were used to identify social zones or management areas.

These documents are located on El Yunque website: http://www.fs.usda.gov/main/elyunque/landmanagement/planning.

1.3 Purpose and Need for Action

The need to revise the current Forest Plan includes: (1) the existing Forest Plan is more than 18 years old and has been amended three times. There is a need to meet the legal requirements of the National Forest Management Act (NFMA) and the 2012 Planning Rule (36 CFR 219); and (2) since the Forest Plan was approved in March 1997, there have been changes in economic, social, and ecological conditions, new policies and priorities, and new information based on monitoring and scientific research. There is a need for these changes to be reflected in the plan. Extensive public and employee involvement, along with science-based evaluations, have helped to further identify the areas of the existing Forest Plan that need to be changed. Additionally, in September 2017, hurricanes Irma and María heavily impacted the Forest further than the already existing changes and will require further monitoring beyond this Environmental Impact Statement to fully assess the extent of their damages in ecological as well as social and economic aspects throughout the region.

From 2013 through 2016, El Yunque National Forest developed the Plan Assessment (USDA Forest Service 2014), the Need to Change (USDA Forest Service 2014, 2015) and the Proposed Management Strategies (USDA Forest Service 2015, 2016). The purpose of these documents was to assess new information, changes in technology, the 2012 Planning Rule, land uses, and to identify what did and did not work well in the 1997 Forest Plan. These assessments and public comments and recommendations were summarized into five areas where a change from current Forest Plan direction is needed:

1. Incorporate collaborative adaptive management at the plan and site-specific levels.

- *Sustain and develop partnerships.* Continue current regional collaboration efforts engaged in conservation, management, and land use in a sustainable manner while seeking out opportunities for further partnership efforts. Shift priorities from primarily a Forest Service-driven management focus to more collaborative management. Partnership opportunities and collaborations support the achievement of desired conditions and objectives of the Plan.
- *Integrate agencies and stakeholders in conservation efforts.* Facilitate and coordinate a framework similar to the concept of a State Technical Committee by integrating agencies and concerned citizens in the region in processes to request support or funds for programs and promote outreach for incentive programs available for private land-owners in the areas adjacent to the Forest.
- *Provide opportunities for research.* Develop initiatives with agencies, academic institutions, and citizen scientist groups for various projects.

2. Define a new recreation, access, and tourism system.

- *Provide for sustainable recreation.* The Forest provides sustainable recreation opportunities that are in harmony and sustainable within the natural setting, where people enjoy and value its unique tropical ecosystem which includes protecting and maintaining historical and cultural recreation resources. Future demands and limited agency resources will require public support and new partnerships to improve recreation facilities and services on the Forest as well as the capacity to support recreation usage without causing damage to the environment.

3. Promote a stronger regional identity in and around the Forest using an "all-lands" policy.

- *Consider the ecological, social and economic needs of the broader landscape*. An area (CIRMA) of community interface for management of resources at the lower elevations of the Forest is sustainably managed in accessible locations suitable for multiple use management and provides for forest products.

4. Increase regional environmental literacy and educating local communities.

- *Connect the surrounding communities to the Forest's natural landscapes.* Assist in developing community capacity for participation in various management activities in areas such as interpretation, education, recreation, economic development, conservation, restoration, research and monitoring. Identify and overcome barriers that inhibit these populations from connecting socially, culturally and economically to the natural landscapes within and surrounding the Forest.

5. Provide for healthy ecosystems

- *Conserve and restore ecosystems.* Protect and conserve the functional wetlands and mature forest and maintain and improve watershed conditions on the Forest while monitoring, adapting and mitigating the impacts of climate change.

1.4 Proposed Action

El Yunque National Forest proposes to revise the 1997 Land and Resource Management Plan for the Caribbean National Forest and Luquillo Experimental Forest, as amended (hereafter referred to as the 1997 Forest Plan), in compliance with the 2012 planning rule (36 CFR 219.17(3)(b)(1)). The proposed action addresses the areas identified in the "El Yunque National Forest – Need for Change" document; the unique roles and contributions of El Yunque National Forest; as well as the collaborative approaches, sustainability management, and social, economic, and ecological needs that have been identified for the Forest. The Forest Plan guides all-natural resource management activities on El Yunque National Forest to meet the requirements of Federal law, regulations and policy. The area affected by the proposal includes the 29,000-acre El Yunque National Forest (map 1-1). See the "Alternatives" section for detailed information.

1.5 Decision Framework

The responsible official for the analysis is the Forest Supervisor for El Yunque National Forest. Based on the analysis and subsequent public comments, the responsible official will prepare a final environmental impact statement and identify a selected alternative in a record of decision that will be subject to an objection process guided by the direction in 36 CFR 219 Subpart B (219.50 to 219.62).

The decision will:

- Establish desired conditions and objectives; goals (which are optional) may also be established;
- Establish Forest wide design criteria (standards and guidelines);
- Establish management areas and geographic areas;

- Determine suitability of land;
- Determine the maximum amount of timber that might be removed;
- Recommend areas for inclusion in the National Wilderness Preservation System (36 CFR 219.7(c)(2)(v)) if applicable; and
- Identify eligible wild and scenic rivers (36 CFR 219.7(c)(2)(vi)) if applicable.

A final record of decision and accompanying Forest Plan sets a course of action for managing the Forest for the next 10 to 15 years. Project-level environmental analysis will still need to be completed for specific proposals to implement the direction in the Forest Plan.

1.6 Public Involvement

The notice of intent (NOI) to prepare an EIS was published in the Federal Register on September 18, 2014 (79 FR, pages 56050-56054). The legal notice was published in the two newspapers of records, *Nuevo Di*a and *San Juan Daily Star* on September 14, 2014. The public was asked to comment on the proposed action by November 3, 2014. From 2014 to 2015 approximately 28 outreach activities and meetings were hosted (see planning record as well as Appendix A). Planning outreach activities included meetings with different communities and the public in general in locations that were accessible to the different municipalities located to the north, east and southwest of the Forest. Meetings were held with stakeholders including recreation outfitters, protected area land managers, municipality planners, the scientific and academic community and the Center for Landscape Conservation (CCP for its acronym in Spanish). The meetings were designed to describe and discuss the existing Forest and resource conditions being used to develop the proposed action; to collect information and comments from the public on land use for the Forest, and to consider suggestions for new alternatives for managing the Forest. Information and recommendations from these planning outreach activities were used to develop the proposed action for the final revised plan. The proposed action was shared with the public through a series of community meetings and interest group meetings to validate its content. The public outreach process spanned more than two years and the complete public involvement process can be found in the planning record. After the formal 90-day comment period on the draft EIS and proposed Forest Plan, the Forest received a total of 14 comment letters were received from the public, agencies, and public interest groups. Six individuals provided substantive comments on the proposed Forest Plan and draft EIS. Five government (federal or state organizations) provided comments. The letters received represent a total of 77 comments.

1.7 Issues

Significant issues are those directly or indirectly caused by implementing the proposed action. These issues drive the range of alternatives and effects analysis. Alternatives were developed around those issues that involved unresolved conflicts concerning alternative uses of available resources. See the "Alternatives" section in chapter 2. No areas of scientific controversy were identified under the proposed action.

The Forest Service separated the issues into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those: (1) outside the scope of the proposed action; (2) already decided by law, regulation, Forest Plan, or other higher-level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…"

A list of non-significant issues and reasons regarding their categorization as non-significant may be found in the project record. Additional information is available on our public website at: http://www.fs.usda.gov/main/elyunque/landmanagement/planning.

Based on comments from Forest Service personnel, the public, other agencies and non-governmental organizations, the following significant issues were identified:

1. What is the best approach to provide sustainable recreation opportunities that minimize impacts to the Forest while meeting current and future needs and demands of users and surrounding communities?

Forest management strategies should determine an appropriate offering of sustainable recreation opportunities that respond to increasing and changing demands while providing for public health and safety, cultural resources stewardship and ecosystem protection (such as soil and water and riparian resources, wildlife habitat, and control of invasive species).

The Forest, a popular tourism destination on the Island and in close proximity to the metropolitan area of San Juan, receives over 1 million visitors annually. Visitors use the Forest for a variety of recreational opportunities such as hiking, water play, sightseeing and camping. Much of the recreational infrastructure used by the public such as the trails, observation towers and picnic areas also constitute historic sites constructed during the 1930s.

People want access to the Forest for recreation, but carrying capacities, user impacts to resources and maintaining sufficient infrastructure to support visitation, need to be determined. The lower elevations of the Forest may be better suited to provide recreation uses or access than the mature forest, cloud forest and wetlands (mainly above 600 meters in elevation); which need protection that may conflict with recreational user demands. Some people want Forest recreation access to be more controlled and limited while others want more access to new areas and some prefer re-use of existing and abandoned sites before developing new ones.

2. What is the best approach to respond to the potential effects of climate change on Forest resources and ecosystem services?

The Forest should be able to contribute to the conservation of ecological system diversity on a landscape scale and simultaneously provide for the needs of diverse plant and animal species, as well as people. Forest uses and management activities may affect soil and water quality; riparian, wetland and watershed resources and the maintenance and restoration of terrestrial and aquatic biodiversity. The Forest may need to address additional challenges that increasing human population and urban development may present.

Ecosystem services are the suite of goods and services from the Forest vital to human health and livelihood and are traditionally viewed as benefits to society. They can include wildlife habitat and diversity, watershed services, carbon storage, and scenic landscapes. These outputs and services can be important to many of the communities around the National Forest.

Climate change may involve droughts or extreme weather events, including hurricanes, which could impact water quantity and quality. The impacts of powerful hurricanes, such as Irma and Maria (September 2017), caused severe defoliation, windthrown trees, wildlife mortality and in general affected the structure and, in some cases, the distribution of species. Changes in climate may require adaptive strategies to facilitate the ability of ecosystems and species to adapt to changes in conditions such as stream temperatures, vegetation composition, wildlife habitat conditions and invasive species.

The Forest will be challenged with protecting and conserving the functional wetlands and mature forest and maintaining and improving watershed conditions while monitoring, adapting to and mitigating the impacts of climate change.

3. How, where, and to what extent can the Forest provide opportunities that contribute to and/or enhance social and economic conditions in the region?

Management activities and uses of El Yunque National Forest may affect the role the Forest plays in the economy of local communities, including the production of ecosystem services. Activities such as tourism, recreation, and agroforestry practices[1] and forest products, are important to local communities. Increasing population and development near the Forest may influence access to the National Forest, management activities such as special use requests, and responses to additional recreation demands and ecosystem services.

El Yunque National Forest should evaluate how to provide and sustainably manage forest products and multiple uses at lower elevations while protecting Forest resources and providing for healthy terrestrial and aquatic ecosystems and watersheds. While there is interest in agroforestry and forest products, there are concerns that techniques and uses are sustainable and do not cause ecological or scenic impacts.

El Yunque National Forest should evaluate how to provide diverse and sustainable developed and dispersed recreation opportunities that consider experiences and offerings off the Forest within the region.

There should be more integration with municipal and Commonwealth plans and planning regulations, as well as collaborative management strategies, which would help to strengthen regional economic and tourism networks.

1.8 Other Related Efforts

The Forest reviewed various planning and land use policies for the eastern part of Puerto Rico including, but not limited to, having discussions with the Puerto Rico Planning Board. The compatibilities of land use plans relating to conservation, water use, recreation and other uses were considered when developing the forest plan. Finally, the forest used information from municipal land use plans, and State and Commonwealth land use plans to express the current condition of the lands in the region when developing effects analysis in the Environmental Impact Statement.

The Forest used the following Land Use Plans, State and Commonwealth Land Use Policies:

- Puerto Rico Department of Natural and Environmental Resources, Comprehensive Wildlife Resources Assessment
- Forest Resources State Wide Assessment
- Puerto Rico Planning Board Land Use Plan
- Municipality Territorial Order Plans
- Puerto Rico Department of Natural and Environmental Resources Water Plan

This final environmental impact statement (FEIS) incorporates by reference (40 CFR 1502.21) the management direction and environmental analysis from the following programmatic decisions:

- Comprehensive River Management Plan

[1] The integration of tree species into crop systems to create social, economic and ecological benefits (Schoeneberger, Bentrup, & Patel-Weynand, 2017)

- Invasive Species Management Plan

Other ongoing efforts influencing the decision to be made:

- Transportation Analysis Plan
- Watershed Condition Framework
- Landownership Adjustment Strategy
- Communication Sites Plan

1.9 Changes from Draft EIS to Final EIS

In response to comments on the draft EIS and further internal reviews, the following is a summary of the primary changes made to the final EIS and the Revised Land Management Plan. Excluding minor editorial and organization changes, clarifications and typographical errors, the modifications are summarized here:

- Addressing and adding language to address invasive species management. The term "invasive species" include what are considered to be pests.
- Updated language for management of aquatic species management.
- Estimation of animal species present in El Yunque National Forest was changed from 166 to approximately 180.
- The cumulative effect stating that "development will improve aquatic habitat and more native species" was deleted.
- Baño de Oro is identified as a National Natural Landmark.
- Desired condition and objective components on water resources were added to address hydrologic connectivity of the rivers flowing from the forest to maintain healthy aquatic fauna.
- Improved language to address the conflicts between recreation and communication facilities.
- Updated language to clarify harvesting activities to provide for forest products within the CIRMA.
- Changed the language in the Plan from "co-management" to "shared stewardship" (in the English version) to meet agency direction.
- Updated the monitoring program to include scale, alerts and responses by resource area.
- Expanded the Ecosystems desired conditions to include better descriptions of their composition, structure and function.
- Included an appendix on compatibility between local land use plans and the Revised Forest Plan.
- Included responses to comments from the comment period in appendix A of this final EIS.
- Updated the appendix in the final EIS on Ecosystems and Species Diversity, and added a table showing the plan components with each at-risk species.
- After the pass of hurricane María, the Affected Environment section was reviewed and updated, as well as minor updates and clarifications throughout the document.

Chapter 2. Alternatives, Including the Proposed Action

Each alternative represents a different management emphasis for El Yunque National Forest that addresses the significant issues identified during the planning process. Each alternative provides a different mixture of goods and services for the public and a different combination of resource outputs, land uses and environmental effects. The alternatives were developed according to NEPA procedures (40 CFR 1502).

2.1 Introduction

This chapter describes and compares the alternatives considered for the Revised Land Management Plan for El Yunque National Forest. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

2.2 Alternative Development

Alternative 1 is the no-action alternative, which reflects the 1997 Forest Plan, as amended.

Alternative 2, the proposed action and preferred alternative, was developed by collaborating with the public for over two years. It is based on the roles and contributions of El Yunque National Forest as well as addressing the management challenges ahead. The current planning regulations, 36 CFR 219, support ecological, social, and economic sustainability as a goal for managing National Forest System (NFS) lands. To meet this requirement, the proposed action (proposed plan) includes desired conditions, objectives, suitability of lands, standards, guidelines, and management area and geographic areas that would provide a management framework for El Yunque National Forest until amended or revised. Desired conditions are long term, and may not be immediately achieved. The proposed plan serves as the principle mitigation tool to avoid, minimize, rectify, or compensate for any adverse environmental impacts associated with multiple use management on El Yunque National Forest.

Alternative 3 was developed to respond to concerns on sustainability. It would reduce the number of maintained trail miles. The alternative would expand wilderness, but would not create a scenic byway management area.

2.3 Alternatives Considered in Detail

In response to issues raised by the public, the Forest Service developed three alternatives, including alternative 1 (no action) (1997 Forest Plan), alternative 2 (proposed action, the preferred alternative), and alternative 3. The planning record includes responses to the significant issues described in chapter 1 as addressed in the proposed action.

2.3.1 Alternative 1 (No Action)

The no-action alternative would continue management under the 1997 Land and Resource Management Plan for the Caribbean National Forest and Luquillo Experimental Forest, as amended. The alternative retains the 1997 Forest Plan goals and objectives, standards and guidelines and nine management area prescriptions (as amended). Management would continue to be focused on four forest types and would retain direction for managing species as management indicator species. Recreation would continue to be

promoted in functional wetlands that are above 600 meters in elevation. One area suitable for wilderness designation (the Baño de Oro Inventoried Roadless Area) would continue to be managed as part of the proposed expansion to the Baño de Oro Research Natural Area, which would continue to provide for long-term watershed research and studies. Three rivers would remain eligible for wild and scenic river designation. This alternative does not address sustainable Forest recreation and does not consider management areas that would create socioeconomic development at a broader landscape perspective.

2.3.2 Alternative 2 (Proposed Action)

Alternative 2 is the proposed action for the final revised Forest Plan. It addresses the public's desire to access the Forest for recreation, information and education; but recognizes carrying capacities and the need to maintain sufficient infrastructure to support visitation. It also addresses multiple-use of the Forest considering ecological, social and economic sustainability. It addresses climate change impacts by shifting recreational opportunities at the lower elevations of the Forest, which are better suited for recreational use by monitoring the effects of climate change with the development of standards, guidelines, and desired conditions that reduce the Forest's carbon footprint. Alternative 2 would address the following ecological and socioeconomic themes.

2.3.2.1 Ecological Themes

Landscape-scale Conservation Efforts

Three geographic areas are identified to provide opportunities for targeted conservation initiatives, such as stream corridors, riparian zones, wild and scenic river corridors, connections to the Corredor Ecológico del Noreste Natural Reserve and other protected areas; and to integrate with conservation easements, donations, and private lands.

Climate Change

Management areas are arranged so they enhance landscape connectivity and maintain wetland conditions that foster amphibian habitat. Alternative 2 also proposes to adapt the recreational opportunities and settings to new climate patterns through plan components that provide for recreational opportunities and settings at lower elevations.

Wetlands

Lands above 600 meters of elevation that have the soil, vegetation and hydrological elements of a functional wetland are recognized. This is a forest condition not dealt with in the 1997 Plan. Plan components and management strategies that protect the current condition, and ensure that functional wetlands are administered in accordance with management requirements are provided.

Vegetation

While the 1997 Plan was developed based on four forest types, Alternative 2 incorporates new information that establishes 15 forest types present in El Yunque National Forest (see 2014 Forest Plan Assessment), and provides management direction that would protect and conserve the riparian zones. This alternative also delineates suitable and unsuitable lands for human uses and has plan components for the new classified forest types that are endemic for Puerto Rico and rare in El Yunque National Forest.

Water

The watercourses within El Yunque National Forest provide many beneficial uses including recreation, fish and wildlife maintenance, in-stream flow, and water level protection. Alternative 2 provides for the beneficial uses of water, incorporates the watershed condition framework, and maintains water quality.

Flora

There are an estimated 830 native and endemic plant species in El Yunque National Forest. Their conservation status was evaluated, and 39 species of conservation concern are identified. Species of conservation concern are designated by the Regional Forester, along with eight plant species that are federally listed as endangered or threatened by the U.S. Fish and Wildlife Service.

Wildlife

For an administrative baseline, the Forest began with 180 animal species found in El Yunque National Forest; that estimated number changed over time with additional comprehensive studies. As a result, 32 species of snails and crustaceans (invertebrate species), 134 vertebrate species, and about 11 orders of insects that include multiple families were added to the Forest species lists.

At-risk species for planning are threatened, endangered, proposed, and candidate species designated by the U.S. Fish and Wildlife Service including four species federally listed as endangered or threatened (Puerto Rican parrot, Puerto Rican broad-winged and sharp-shinned hawks, and the Puerto Rican boa). The elfin-woods warbler, which was recently proposed for listing, is also included. The revised plan also lists 23 faunal species of conservation concern consisting of coquies, anole lizards, bats, birds, fishes, freshwater shrimps and snails.

Focal Species

Five species groupings would be monitored as focal species: one group of four bird species, one group of four amphibians (different coquíes), one group of one aquatic species, and one group of six invasive species.

Invasive species

Direction for restoring and expanding the range of native species is provided. Direction to better control the introduction and spread of invasive species on the Forest is also provided, including minimizing the spread of invasive plants that may increase as a result of management activities.

2.3.2.2 Social and Economic Themes

Connect with Communities through Recreation

The communities surrounding the Forest represent a broad range in recreation needs and demands. Alternative 2 identifies recreational settings available outside the Forest boundary that would permit increased integration of access, recreation, and aspects of tourism at the sub-regional level. It also provides opportunities to better connect urban areas and rural communities to the scenic attractions, historic places, and recreation opportunities located in the lower elevations of the Forest. A scenic route management area is also created.

Increase Environmental Literacy and Education

Throughout the planning process the public has communicated an interest in the Forest's role in environmental education. Alternative 2 enhances the surrounding communities' connection to the Forest's natural landscapes. It provides opportunities to help develop community capacity for participation in various management activities through recreation, increased environmental literacy and education; enhance landscape scale conservation efforts, and strengthen collaborative relationships and adaptive, shared stewardship approaches.

Strengthen Collaborative Relationships and Adaptive, Shared Stewardship Approaches

Three new geographical areas are identified that would allow the Forest to increase its engagement with local community stakeholders and Forest users. Opportunities for addressing new scientific information on, and changes in: social, economic, and ecological conditions within and around the Forest are also provided.

Community Interface Resource Management Area (CIRMA)

The Community Interface Resource Management Area (community interface or CIRMA) is the best example of the shift from Forest Service-driven management priorities to a more collaborative management and is the identified area where sustainable Forest practices could be considered with a community-based shared stewardship approach. Some CIRMA management strategies include agroforestry approaches, providing forest products to promote local businesses and local artisans, in addition to municipal collaboration projects to develop low impact recreational sites, trails and cultural resource interpretation programs.

Monitoring

Alternative 2 includes an extensive monitoring plan. Public input indicates interest in commitment to a citizen based collaborative approach to monitoring, combined with support from regional protected area managers.

2.3.2.3 Wilderness Inventory and Evaluation, and Wild and Scenic Rivers

Based on the wilderness inventory (see appendix D), one area that may be suitable for wilderness designation (Management Area–Baño de Oro) was identified. Alternative 2 does not recommend any additional areas for wilderness designation, including Baño de Oro. This is because over one-third of the Forest is within the designated El Toro Wilderness and there is lack of public support for additional lands to be designated as wilderness.

The 1997 Plan EIS evaluated 15 rivers for wild and scenic river eligibility, classification, and suitability. Three rivers were congressionally designated; the Río Mameyes, Río de la Mina and Río Icacos. Three rivers remain eligible; the Río Espíritu Santo/Quebrada Sonadora, Río Fajardo, and Río Sabana. Alternative 2 does not identify any new rivers as eligible and does not propose any new wild and scenic river recommendations.

2.3.2.4 Geographic Areas

Alternative 2 proposes three geographic areas (map 2-1). Each geographic area encompasses a large area of land that is closely tied to the communities, conditions, and relationships beyond the Forest boundary:

El Norte-North (Rio Grande and Luquillo)

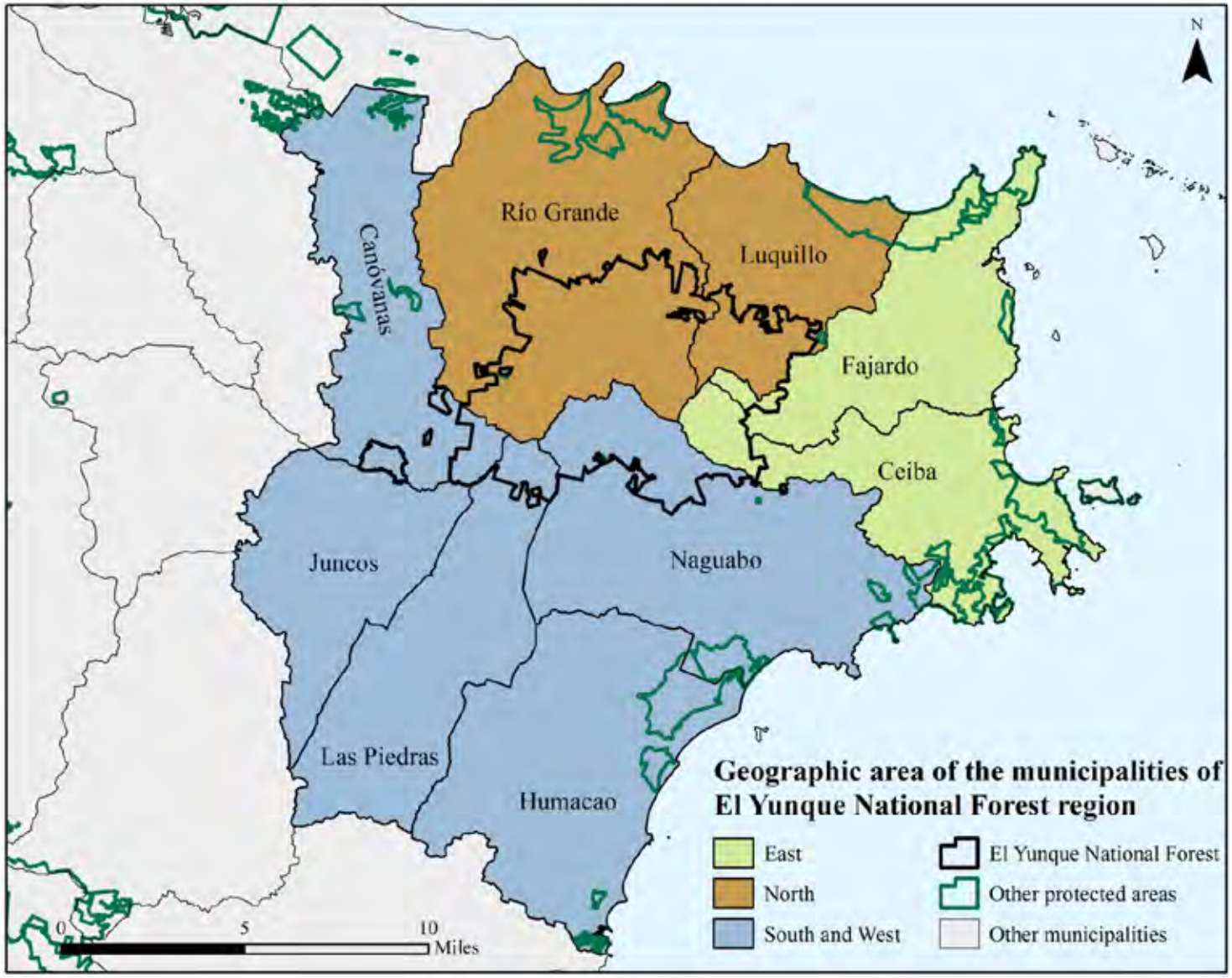
- Provides access to recreation settings and connects to a regional trail system.

El Suroeste-Southwest (Canóvanas, Juncos, Las Piedras, Naguabo and Humacao)

- This geographic area focuses on community-based use with an emphasis on environmental education and community enterprises.

El Este- East (Fajardo and Ceiba)

- This geographic area is based on watershed management and is focused on water quantity and watershed restoration and improvement.



Map 2-1. Alternative 2 geographic areas

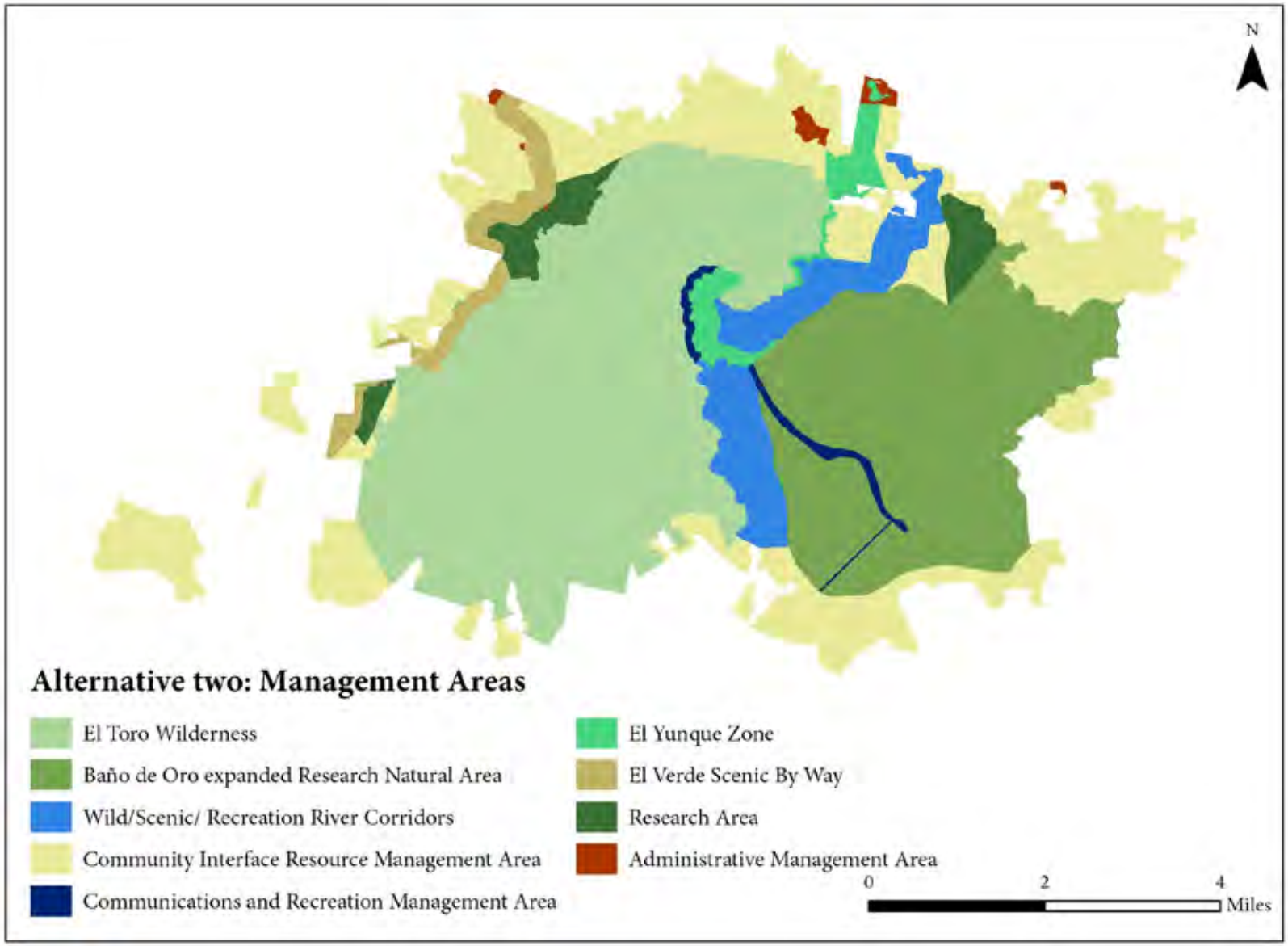
2.3.2.5 Management Areas (MA)

Alternative 2 proposes nine management areas (map 2-2). Table 2-1 describes the emphasis for each management area.

This alternative also retains existing Forest Plan direction (including standards and guidelines) for the research, wild and scenic rivers, and wilderness management areas.

Table 2-1. Alternative 2, management areas

Management Area Number	Name	Acreage	Description	Management emphasis for the Management Area
MA 1	Administrative Sites	141	Areas occupied by El Portal Forest Center, Catalina Work Station, and other Forest Service administrative facilities.	Emphasis is placed on transitioning to Green Buildings, recycling, use of alternative energy and reducing carbon footprint. Facilities are shared with partners.
MA 2	El Yunque Recreation Zone	844	El Yunque Zone covers El Yunque Trail, Mount Britton Trail, Forest Service Road 10 and Big Tree Trail.	Area where emphasis is on use of existing developed recreation sites managed by capacity with strong emphasis on sustainability.
MA 3	Communication and Recreation Sites	241	Areas on El Yunque Peak and Pico del Este used for communication facilities, access roads to the communications sites, electrical power lines and recreation sites.	Communication facilities' footprint is reduced and facilities are energy efficient. Access to recreational settings that provide unique scenic and natural experience is maintained.
MA 4	Community Interface Resource Management Area	7,187	This consolidation of lands under one management area provide sections of the Forest where an assortment of resource management practices could be applied to encourage tropical forest management initiatives in the broader landscape of El Yunque National Forest.	Management focuses on community-based shared stewardship, and improves access to lower lands.
MA 5	El Toro Wilderness	10,352	Designated area on the southwestern portion of the Forest.	Manage the area to maintain it within wilderness characteristics.
MA 6	Research Bisley and El Verde Station	789	Research, including long-term watershed studies and treatment/ control studies, is emphasized.	Facilitate tropical ecosystem studies at the landscape scale.
MA 7	Baño de Oro Expanded Research Natural Area	6,441	Existing and proposed research natural area (RNA). The existing Baño de Oro research natural area is expanded to encompass all of the mature forest area in east half of the Forest.	Implement non-manipulative studies. Maintained in undisturbed condition for current and future non-manipulative research.
MA 8	Wild Scenic Recreation River Corridors	1,531	Corridor along the Icacos, Mameyes, La Mina and Upper Mameyes designated as Wild and Scenic Rivers	Where protection of these rivers' outstanding characteristic is emphasized.
MA 9	El Verde-Scenic Byway Management Area	697	A 600-meter band of the PR 186 Road right-of-way from the Community Interface Resource Management Area.	Protect scenery and develop a scenic byway.

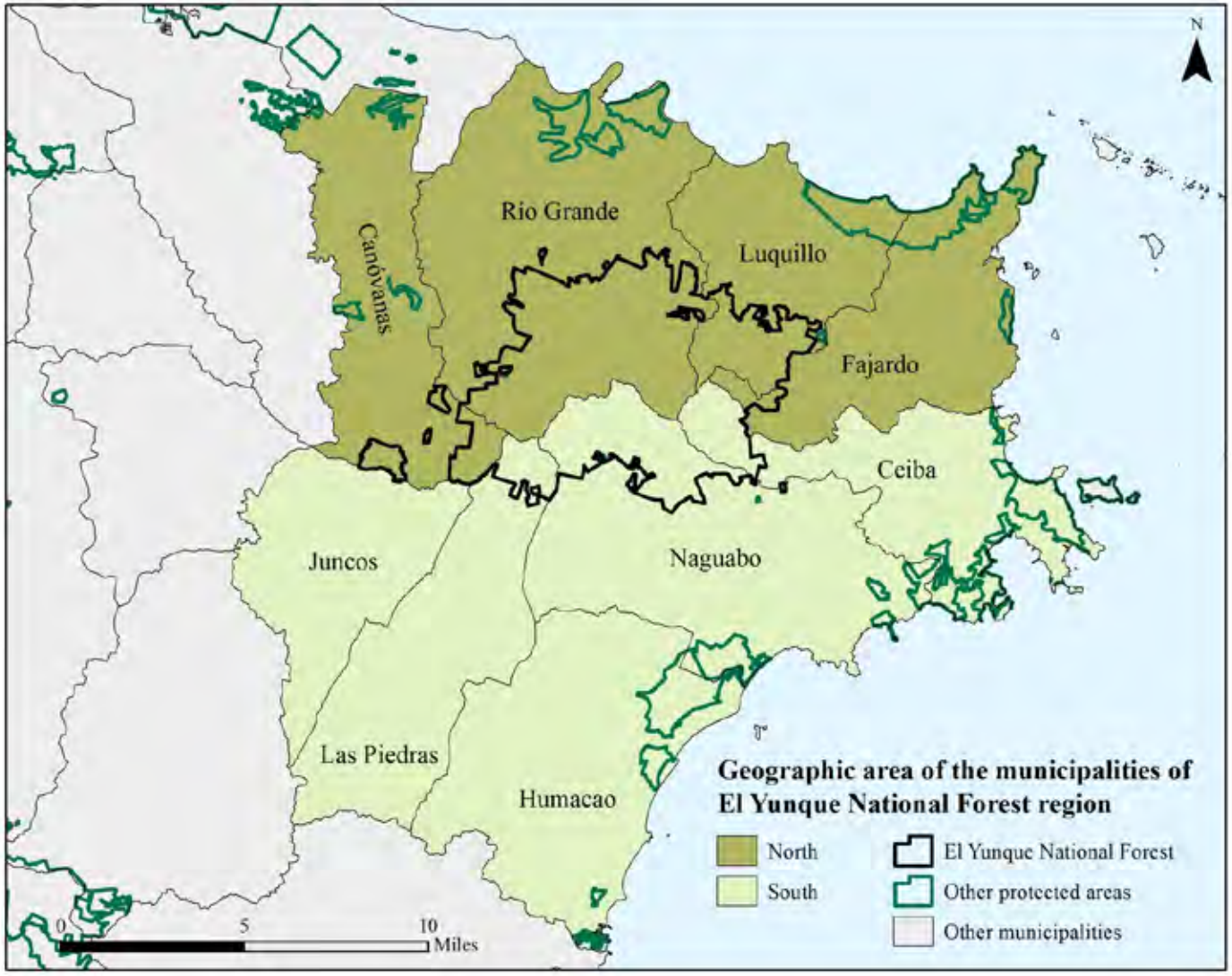


Map 2-2. Alternative 2 management areas

2.3.3 Alternative 3

Alternative 3 was developed in response to concerns on recreation sustainability. This alternative is based on alternative 2, but with the following changes which:

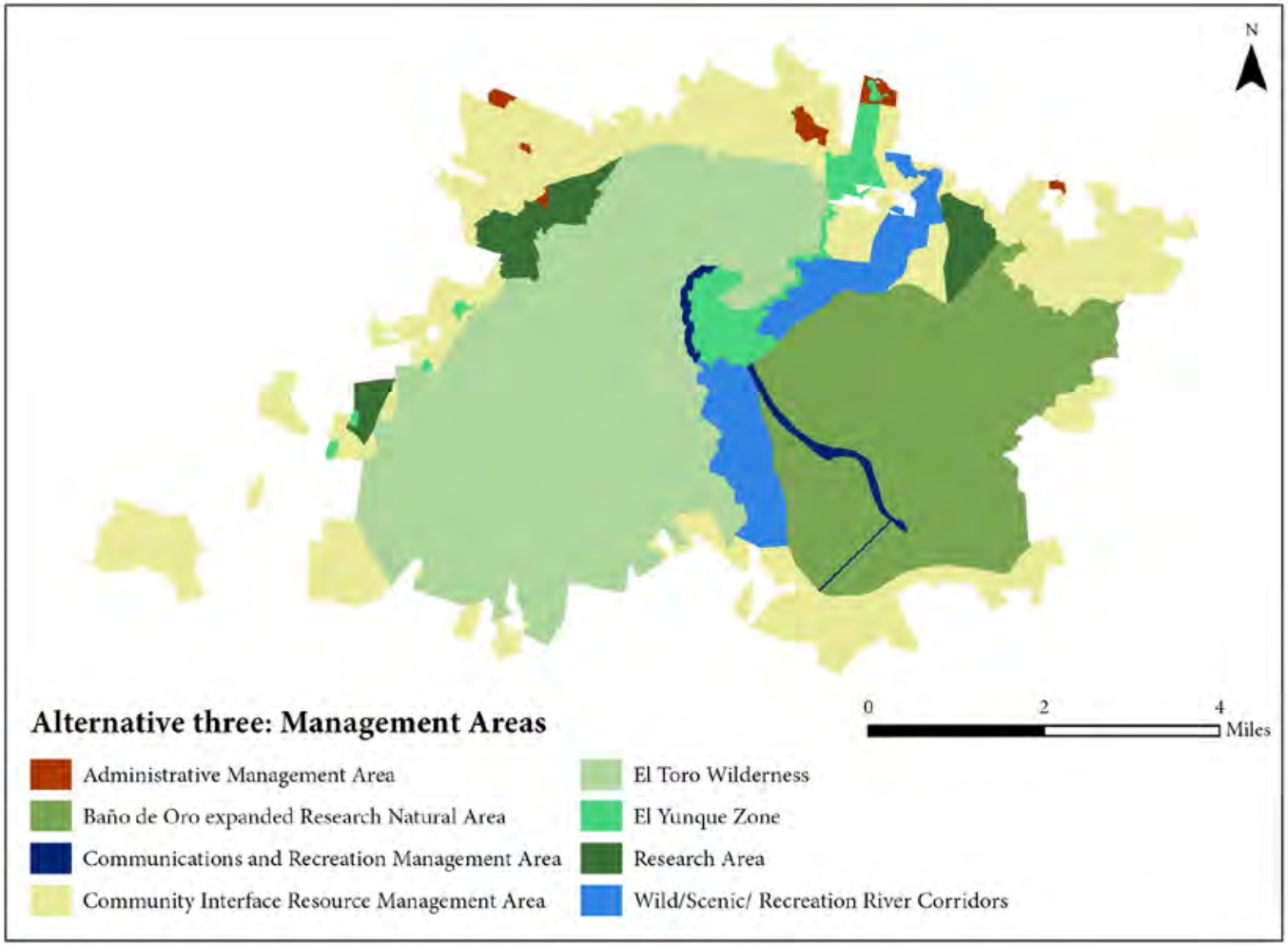
- Recommends designating the Baño de Oro Research Natural Area as wilderness.
- Excludes the proposed scenic byway management area for PR 186.
- Provides additional plan components to address invasive species management in areas of road rights-of-way, recreation areas, and threatened and endangered habitats in order to promote management of Invasive species and to restore landscape level conditions.
- Addresses some sustainable recreation concerns by reducing the trail system to a level that can be maintained.
- Creates two geographic areas: North and South to connect with communities on both sides of the Forest. North includes Canóvanas, Río Grande, Luquillo and Fajardo municipalities. South includes Juncos, Las Piedras, Naguabo, Humacao and Ceiba.



Map 2-3. Alternative 3 geographic areas

Table 2-2. Alternative 3, management areas

Management Area Number	Name	Acreage	Description	Management emphasis for the Management Area
MA 1	Administrative Sites	141	Areas occupied by El Portal Forest Center, Catalina Work Station, and other Forest Service administrative facilities.	Emphasis is placed on transitioning to Green Buildings, recycling, use of alternative energy and reducing carbon footprint. Facilities are shared with partners.
MA 2	El Yunque Recreation Zone	844	El Yunque Zone covers El Yunque Trail, Mount Britton Trail, Forest Service Road 10 and Big Tree Trail.	Area where emphasis is on use of existing developed recreation sites managed by capacity with strong emphasis on sustainability.
MA 3	Communication and Recreation Sites	241	Areas on El Yunque Peak and Pico del Este used for communication facilities, access roads to the communications sites, electrical power lines and recreation sites.	Communication facilities' footprint is reduced and facilities are energy efficient. Access to recreational settings that provide unique scenic and natural experience is maintained.
MA 4	Community Interface Resource Management Area	7,884	This consolidation of lands under one management area provide sections of the Forest where an assortment of resource management practices could be applied to encourage tropical forest management initiatives in the broader landscape of El YunqueNational Forest.	Management focuses on community-based shared stewardship, and improves access to lower lands.
MA 5	El Toro Wilderness	10,352	Designated area on the southwestern portion of the Forest.	Manage the area to maintain it within wilderness characteristics.
MA 6	Research Bisley and El Verde Station	789	Research, including long-term watershed studies and treatment/ control studies, is emphasized.	Facilitate tropical ecosystem studies at the landscape scale.
MA 7	Baño de Oro Expanded Wilderness Area	6,441	Existing and proposed research natural area (RNA) will be proposed for wilderness designation.	Maintained in undisturbed condition for current wilderness designation.
MA 8	Wild Scenic Recreation River Corridors	1,531	Corridor along the Icacos, Mameyes, La Mina and Upper Mameyes designated as Wild and Scenic Rivers	Where protection of these rivers' outstanding characteristic is emphasized.



Map 2-4. Alternative 3 management areas

2.4 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14).

Public comments received in response to the proposed action provided suggestions for alternative methods of achieving the purpose and need. Some of these alternatives may have been outside the scope of what can be included in the final revised El Yunque Forest Plan, duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Four alternatives were considered but dismissed from detailed consideration for reasons summarized below.

Custodial (no recreation management, special uses or research management)

This alternative was not considered in detail because it does not meet law or policy requirements to provide multiple uses. This alternative would not comply with the dual designation of El Yunque National Forest as also the Luquillo Experimental Forest.

Intensive recovery of the Puerto Rican parrot

This alternative was not considered in detail because in the 1997 Forest Plan it was accepted, but not scientifically supported, that El Yunque was potentially prime habitat that would support a viable parrot population. Since then, interagency recovery research has found El Yunque National Forest is not optimal habitat for the Puerto Rican parrot, and is focusing recovery efforts in better habitats to the west of the Forest (White et al. 2014). Therefore, the new plan will keep Puerto Rican parrot recovery as an important management objective and continue to be in compliance with all relevant Federal and State land management regulations, but will not continue to manage the Forest as habitat critical to the recovery of the species.

Recommending designation of all eligible wild and scenic rivers

This alternative was not considered in detail for the following reasons:

- There is public opposision in wild and scenic river designation for three rivers;
- Additional areas would increase management complexity; and,
- People would still like to have access to these areas.

2.5 Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Table 2-3 qualitatively compares the alternatives by the significant issues identified during the public participation process. Table 2-4 compares the alternatives by management area allocation acres. Table 2-5 compares timber suitability acres and timber volume by alternative. Table 2-6 compares recommended wilderness acres by alternative.

Table 2-3. Comparison of alternatives by significant issues

Significant Issues	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3
Issue 1. What is the best approach to provide sustainable recreation opportunities that minimize impacts to the Forest while meeting current and future needs and demands?	The 1997 Plan does not include plan components that address sustainable recreation. The plan increases the recreational opportunity; therefore, impacts will be expected to increase. This alternative helps us to meet current and future demands regardless of impacts. The alternative does not contemplate the impacts of recreation site development.	The alternative provides for sustainable recreation by including plan components that consider wetlands, community interface areas, limits on capacity and funding. The alternative addresses current conditions of cultural resources, the need to protect sensitive areas at higher elevations, disperse the recreational opportunity away from PR Road 191 in order to decrease crowding and improve setting.	This alternative provides for sustainable recreation. The plan reduces the recreational opportunity and setting by reducing the trail system. The alternative responds to the issue by reducing capability to meet demands.
Issue 2. What is the best approach to respond to the potential effects of climate change on the Forest resources, ecosystem services and others?	This alternative does not respond to the issue. There are no specific plan components in response to climate change.	The alternative contains plan components that focus on climate change.	The alternative responds to the issue by promoting species management on threatened and endangered habitats and invasive species. Provides a stronger response to climate change.
Issue 3. How, where, and to what extent can the Forest provide opportunities that contribute to/enhance social and economic conditions in the region?	The Forest's main contributions to the social and economic condition would continue to include recreation, water and biodiversity. The alternative responds to the issue by maximizing outputs of recreational opportunities, providing for water, timber products and research within the Forest.	The alternative responds to the issue by introducing recreational sustainability, establishing plan components for recreation along Road 191 and shifting recreation opportunities to lower elevations, establishing a new access, recreation and tourism strategy based on collaboration and community partnerships. It best promotes existing and new economic opportunities tied to the Forest, particularly through the development or demonstration of multiple, sustainable uses in the CIRMA and nearby communities	This alternative responds to the issue by reducing recreational opportunity within the National Forest System lands while promoting recreational opportunities off National Forest System lands.

Table 2-4. Comparison of alternatives by management area (acres)

Management Area	Alternative 1 1997 Forest Plan	Alternative 2 Proposed Action	Alternative 3
Priority Watersheds (number)	N/A	1	1
Wild and Scenic Rivers (number of eligible rivers)	3	3	3
Management Area 1 (acres) Administrative Sites	161	141	141
Management Area 2 (acres) El Yunque Zone	-	844	844
Management Area 2 Developed Recreation	844	-	-
Management Area 3 (acres) Communication Sites	241	241	241
Management Area 4 (acres) Community Interface Resource Management Area (CIRMA)	-	7,187	7,187
Management Area 4–Integrated (acres)	6,225	-	-
Management Area 5 (acres) El Toro Wilderness	10,352	10,352	16,793
Management Area 6 (acres) Research	789	789	789
Management Area 7 (acres) Research Natural Area	6,396	6,441	6,441
Management Area 8 (acres) Wild and Scenic Recreation River Corridors	-	1,531	1,531
Management Area 8- Timber Demonstration	1,167	-	-
Management Area 9 (acres) El Verde -Scenic Byway	-	697	-
Management Area 9 Scenic and Recreation River Corridors	1,295	-	-

Table 2-5. Comparison of acres suitable for timber production and estimated 10-year timber volume by alternative

Timber Suitability and Volume Criteria	Alternative 1	Alternative 2	Alternative 3
Land Classified as Suitable for Timber Production (acres)	1,167	7,187	7,187
Percent of Land Ownership Classified as Suitable for Timber Production (percent)	0	25	25
Sustained Yield Limit (MCF/year)		591.6	591.6
Projected Wood Sale Quantity (MCF/year), 1st decade	23	23	23

Note: MCF = Thousand cubic feet

Table 2-6. Summary of proposed wilderness by alternative

Existing Area	Alternative 1 1997 Plan	Alternative 2 Proposed Action	Alternative 3
El Toro Wilderness (acres)	10,363	10,352[1]	10,352
Inventoried Roadless Area (acres)	6,441	6,441	
Proposed Additional Wilderness (Baño de Oro) (acres)	0	0	6,441

1-New acreage based on GIS delineation process

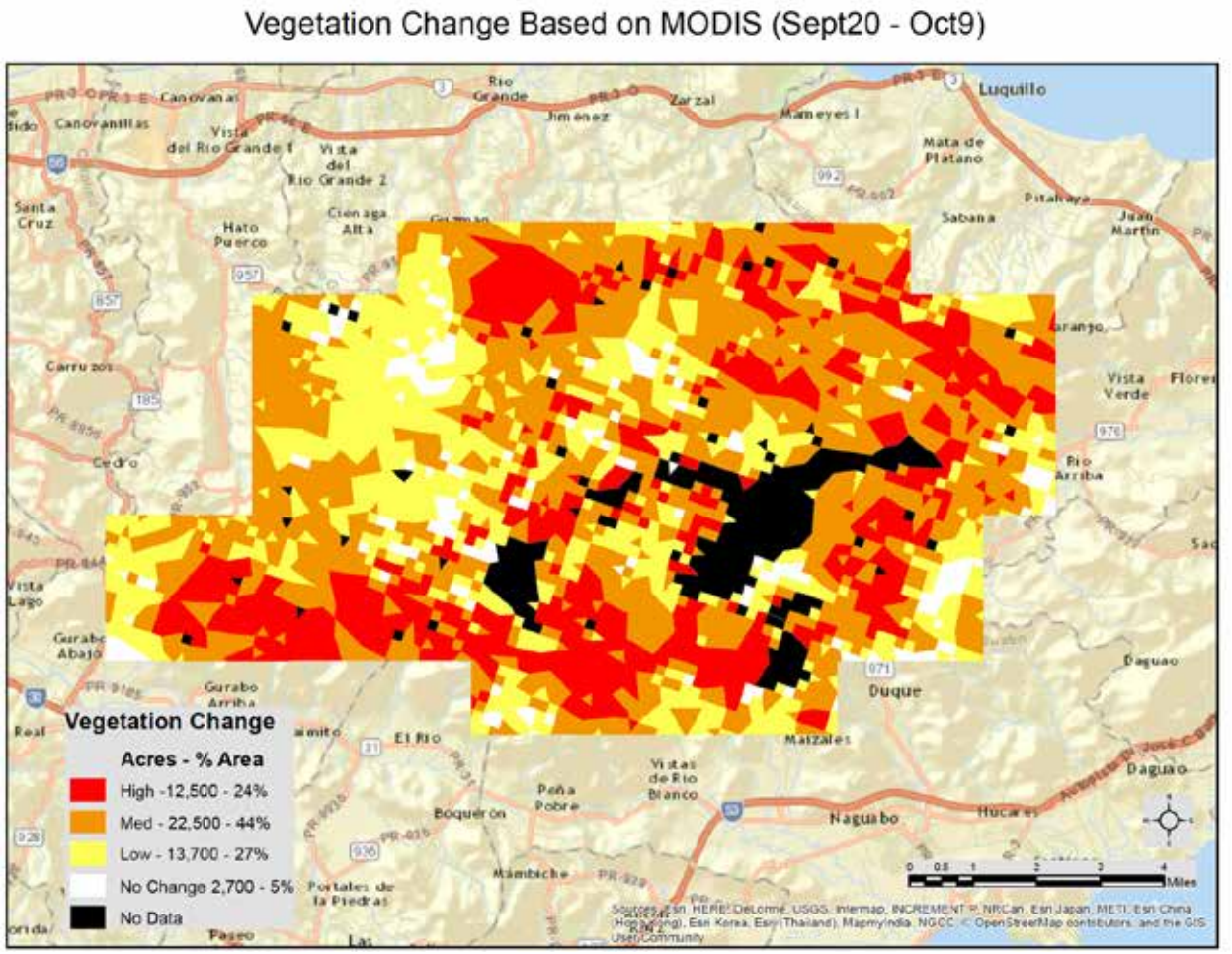
Chapter 3. Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the potential environmental consequences of implementing each alternative on that environment. The kinds of resource management activities allowed under each of the alternatives are reasonably foreseeable future actions to achieve the goals and objectives in the plan. However, the specific location, design, and extent of such activities are generally unknown. Therefore, the discussions in this chapter refer only to the potential for an effect to occur. The intent is to provide scientific analysis and information that allows a comparison of the alternatives and provide the basis for an informed decision. Information in this chapter is based on resource reports and supporting material, and all resource reports are incorporated by reference. Most resource analyses are available for viewing in the planning record or the Forest website. Those not on the website are available upon request. All reports are filed in the planning record.

The Forest specialists developed their effects analysis considering the need for change and therefore need to revise the current plan. They also took into account the public comments to develop the alternatives, which address the issues that the Forest faces in its current condition. This analysis was developed in a matrix form, with each alternative analyzed to determine and consider how it would potentially affect the resources. Throughout the process we considered the public comments and need for revision identified as part of the analysis.

It should be noted that for the effects analysis alternative 1 is being analyzed at the same level as alternatives 2 and 3. However, alternative 1 is not being considered as a reference point or representative of the current conditions of the Forest (for the sake of effects analysis). The reason for this is that only a section of the policies outlined in the 1997 Plan were implemented (i.e., wilderness area, wild and scenic river designations). As such, the 1997 Plan only partially affected the current condition of the Forest. It is noteworthy to mention that alternative 1 (representative of the 1997 Plan) did not address significant factors present in the new planning rule (2012), such as sustainability and collaboration (i.e., "Plans will guide management of NFS [National Forest System] lands so that they are ecologically sustainable and contribute to social and economic sustainability…") (Section 219(1)(c), New Planning Rule 2012)). There is a gap between the old and the new planning rule, which creates inconsistencies between the requirements of the two sets of regulations for Forest land management planning. This translates to alternative 1 (no action) and alternatives 2 and 3 presenting different criteria and issues that were addressed in the planning phase and which are analyzed in the final EIS. As such, alternatives 2 and 3 contain elements not present in alternative 1.

After the pass of hurricane María on September 20, 2017, the Forest reviewed the changed conditions and effects of the hurricane on the Forest up to December 2017. In terms of ecological effects, almost the entire Forest was defoliated immediately after the hurricane. Preliminary data on vegetation change throughout the Forest is shown in map 3-1, though not in detail, using 250-meter resolution. As of December 2017, the Forest was closed to the public almost in its entirety and recreation opportunities were greatly reduced due to loss of access, unsafe conditions on main roads and trails, and damaged recreation facilities, including El Portal Visitor Center. The closure of the Forest also resulted in lost revenue and reduced income-generating activities for the Forest, outfitters, guides, and concessionaires, among others.



Map 3-1. Vegetation change in El Yunque National Forest after hurricanes Irma and María based on MODIS

3.1 Assumptions

- The Forest Plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity (including ground-disturbing actions). As a result, there are no direct effects. However, there may be implications, or longer-term indirect or cumulative environmental consequences from managing the Forests under this programmatic framework.
- Before any ground-disturbing actions take place, they must be authorized in a subsequent site-specific environmental analysis. Therefore, none of the alternatives would cause unavoidable adverse impacts or an irreversible or irretrievable commitment of resources.
- The plan decisions (desired conditions, objectives, standards, guidelines, management areas, and monitoring) will be followed when planning or implementing site-specific projects and activities.
- Law, policy, and regulations will be followed when planning or implementing site-specific projects and activities.
- Funding levels will be similar to the past 5 years.
- The planning timeframe for the effects analysis is 10 to 15 years; although other timeframes may be specified in the analysis depending on the resource and potential consequences.

3.2 Cumulative Effects

"Cumulative effects" is defined in the Council of Environmental Quality's NEPA regulations as the "impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions…" 40 CFR 1508.7. The Council on Environmental Quality interprets this regulation as referring only to the cumulative impact of the direct and indirect effects of the proposed action and its alternatives when added to the aggregate effects of past, present, and reasonably foreseeable future actions on all land ownerships across an area that is deemed appropriate for the impacts being analyzed.

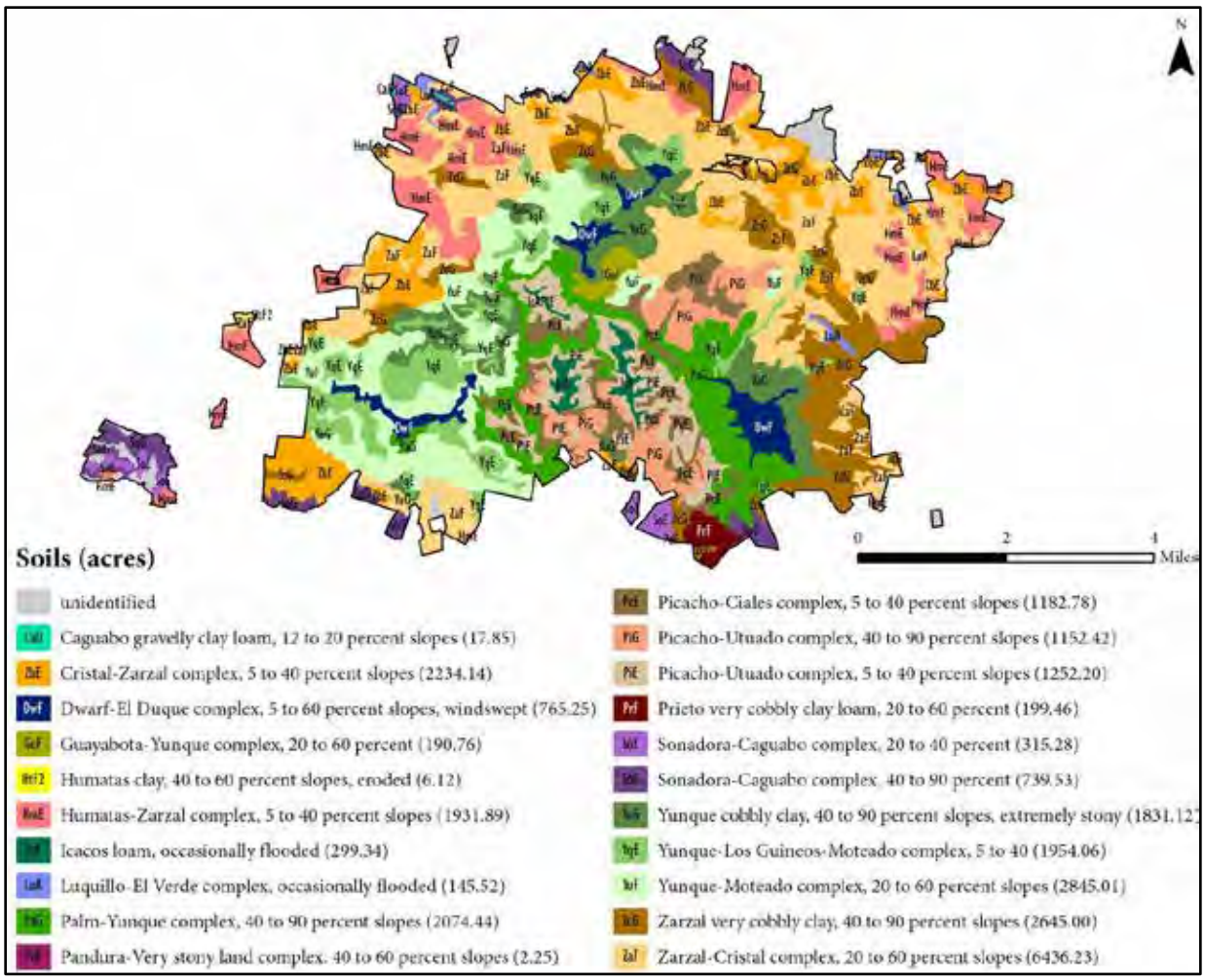
For this analysis, the geographic area of consideration is likely to vary by resource and may differ in spatial scale, as well as the activities that are considered in cumulative effects discussions for each resource. The cumulative effects analyses contained in this chapter do not attempt to quantify the effects of past human actions by adding up all prior planning actions on an action-by-action basis. In order to understand the contribution of past planning actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past planning actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events. It is difficult to quantify how these aggregates have affected the environment and how they might contribute to cumulative effects. Unless otherwise identified, cumulative effects are considered for the expected life of the revised Forest Plan (10 to 15 years).

3.3 Physical Environment

3.3.1 Soils

The soils information for El YunqueNational Forest can be accessed and reviewed in the Soil Survey Geographic Database (SURGO). The information in the database is certified as of October 24, 2012. The soil properties are considered static since the previous management plan. Only management activities related to the maintenance of the existing facilities and road access produced minimum and localized soil surface disturbances. The activities considered in the Forest Plan that can disturb the soil resources include recreation management, road maintenance, improvements in the scenic byways, and forest product utilization. The main concerns of the considered practices are the compaction, erosion, and reduction of the organic layer in the Forest. Healthy soils are critical for the Forest functions and to conserve activities essential for the regions and municipalities such as regulating water, sustaining of plant and animal life, cycling nutrients and physical stability and support.

El Yunque National Forest has a mosaic of soils including hydric soils which are "formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" as defined by the National Technical Committee for Hydric Soils (*Federal Register*; July 13, 1994). Proposed Forest Plan management area directions include standards and guidelines as well as mitigation measures and monitoring plans to limit and reduce any long-term effects to soils for the considered alternatives.


N
Soils (acres)
0
2
4
Miles
unidentified
Caguabo gravelly clay loam, 12 to 20 percent slopes (17.85)
Cristal-Zarzal complex, 5 to 40 percent slopes (2234.14)
Dwarf-El Duque complex, 5 to 60 percent slopes, windswept (765.25)
Guayabota-Yunque complex, 20 to 60 percent (190.76)
Humatas clay, 40 to 60 percent slopes, eroded (6.12)
Humatas-Zarzal complex, 5 to 40 percent slopes (1931.89)
Icacos loam, occasionally flooded (299.34)
Luquillo-El Verde complex, occasionally flooded (145.52)
Palm-Yunque complex, 40 to 90 percent slopes (2074.44)
Pandura-Very stony land complex, 40 to 60 percent slopes (2.25)
Picacho-Ciales complex, 5 to 40 percent slopes (1182.78)
Picacho-Utuado complex, 40 to 90 percent slopes (1152.42)
Picacho-Utuado complex, 5 to 40 percent slopes (1252.20)
Prieto very cobbly clay loam, 20 to 60 percent (199.46)
Sonadora-Caguabo complex, 20 to 40 percent (315.28)
Sonadora-Caguabo complex, 40 to 90 percent (739.53)
Yunque cobbly clay, 40 to 90 percent slopes, extremely stony (1831.12
Yunque-Los Guineos-Moteado complex, 5 to 40 (1954.06)
Yunque-Moteado complex, 20 to 60 percent slopes (2845.01)
Zarzal very cobbly clay, 40 to 90 percent slopes (2645.00)
Zarzal-Cristal complex, 20 to 60 percent slopes (6436.23)

Map 3-2. Soils on El Yunque National Forest

Note: Soil map developed by Maya Quiñones.

3.3.1.1 Affected Environment

The Natural Resources Conservation Service (NRCS) describes the soil as a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following: horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment.

The soils of El Yunque National Forest have been developed and modified by a series of natural factors which are:

- Climate
- Rainfall
- Temperature
- Plant and animal life
- Parent material
- Topography
- Time

Within Forest boundaries, the reduction of soil integrity is a function of landslides and subsequent erosion. Landslides are common both far and near from roads associated to rain events. Illegal off-road vehicle use in the Forest is another activity impacting soils and accelerating erosion.

The following soil unit types (from map 3-2), or parts of map units which are complexes, meet the definition of hydric soils and have at least one of the hydric soil indicators. This list can help in planning land uses and updates the hydric soils previously noted in the Forest.

135 Prieto very cobbly clay loam

212 Yunque-Moteado complex, 20 to 65 percent slopes (Moteado part)

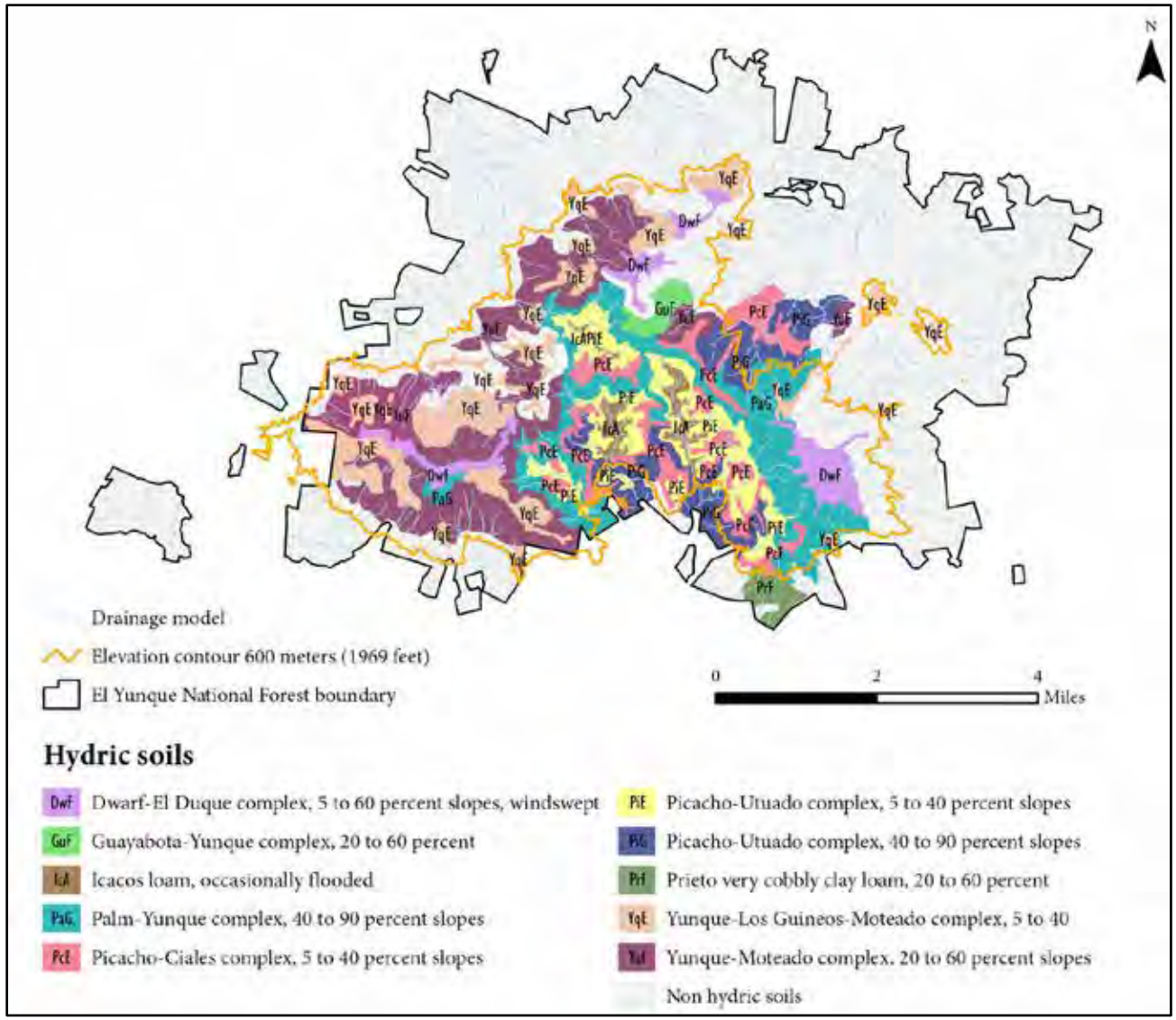
214 Yunque-Los Guineos-Moteado complex, 5 to 30 percent slopes (Moteado part)

215 Palm-Yunque complex, 35 to 85 percent slopes, extremely stony (Palm part)

223 Picacho-Ciales complex, 5 to 30 percent slopes (Ciales part)

231 Guayabota-Yunque complex, 30 to 60 percent slopes (Guayabota part)

311 Dwarf muck, 10 to 65 percent slopes, windswept


N
Drainage model
Elevation contour 600 meters (1969 feet)
El Yunque National Forest boundary
0
2
4
Miles
Hydric soils
DwF Dwarf-El Duque complex, 5 to 60 percent slopes, windswept
GuF Guayabota-Yunque complex, 20 to 60 percent
IcA Icacos loam, occasionally flooded
PaG Palm-Yunque complex, 40 to 90 percent slopes
PcE Picacho-Ciales complex, 5 to 40 percent slopes
PtE Picacho-Utuado complex, 5 to 40 percent slopes
PtG Picacho-Utuado complex, 40 to 90 percent slopes
Prf Prieto very cobbly clay loam, 20 to 60 percent
YqE Yunque-Los Guineos-Moteado complex, 5 to 40
YuF Yunque-Moteado complex, 20 to 60 percent slopes
Non hydric soils

Map 3-3. Hydric soils, El Yunque National Forest (developed by Maya Quiñones)

3.3.1.2 Environmental Consequences

The recreational activities associated with the number of visitors using the Forest are considered the ones that most likely will cause compaction, rutting, and impact over the organic surface. Other activities like road and trail maintenance can reduce soil productivity because of potential landslides and associated erosion. The analysis of the alternatives for the plan takes into consideration the pressure that these activities can produce on the soils of the Forest. The effects of other activities are managed through the standards and guidelines as well as the applicable best management practices. They would affect soil resources minimally and are discussed generally.

Compaction is defined by the increase in soil bulk density due to an external force. Activities ranging from heavy equipment to the accumulative weight applied by hikers on the Forest trails can alter the chemical and physical properties of soil. The main concern of soil compaction is the reduction of productivity by retarding root growth as well as changes in air and water/nutrient transfer in the soil. The impact can be most significant in wet soils and special mitigation practices are considered in the Forest trail system to reduce these impacts. The documentation of the hydric soils of the Forest and the restriction in activities through these soils reduce potential impacts in sensitive and less resilient soils.

Areas over 600 meters in elevation were identified in the plan as sensitive and reclassified as functional wetlands. These are addressed specifically as part of alternatives 2 and 3. The management plan would protect all hydric soils above the 600-meter elevational line in El Yunque National Forest (identified in the latest El Yunque soil survey of 2012). The periodic evaluation of the trails system and the application of best management practices will maintain soil conditions within acceptable standards. The management plan includes guidelines directed toward the stabilization of dispersed recreation sites that have exposed and/or highly compacted erodible mineral soils.

Erosion is a process in which the topsoil is removed faster than it is formed; and it can happen due to natural, human, or animal activity. Soil erosion results in land infertility and can require special management practices to reduce the erosion or to recover the soils natural characteristics. Erosion is an important process that needs to be considered and monitored in El Yunque forests because of the slopes, the changes in elevation, and action of rain and visitors.

Landslides are common, constantly reshaping the dynamic topography of the Forest. This type of soil displacement usually occurs during periods of high rainfall (Larsen and Torres-Sánchez 1992). Most landslides occur on the south side of the Forest, and are most common between 600 and 800 meters elevation. Commonly the failure surface for landslides, particularly the larger ones, is in the diorite derived soils (Río Blanco soils complex), along the contact with the surrounding soils derived from Cretaceous volcanic rocks. The largest recent landslides on the Forest are located in the Icacos Valley on the south side of the Forest, along Highway 191 (Guariguata and Larsen 1990; Larsen and Simon 1990). The management plan includes parameters directed toward stabilizing exposed soils caused by landslides.

Vegetation management related to timber is associated with alternative 1. Alternatives 2 and 3 consider the utilization of wood products in the community interface resources management areas. The activities under alternatives 2 and 3 would be in the secondary montane forest classification. As part of the proposed management strategies in the Forest Plan, the soils in the secondary montane forest will be evaluated to identify soil formation stages and their contribution to appropriate ecosystem services. The management plan established the use of native vegetation as much as possible in watershed restoration and soils conservation projects. The design and implementation of vegetation treatments for wildlife habitat improvements are considered under standards that reduce soil exposure and protect sensitive areas.

Recreation offerings in the Forest include the use of several recreation sites (see table 3-22, El Yunque National Forest recreation sites, in the 2014 Forest Plan Assessment) and trails providing a primitive recreation experience that limits soil exposure and other associated impacts. The Forest Plan considers a planned and properly designed network of facilities, roads, and trails as part of the recreation goals for the Forest. Stimulating the use and improvement of trails in the geographic region as part of the recreation considerations in the plan objectives, represents an action directed toward reducing impacts associated with recreational activities in sensitive areas of the Forest. The Forest Plan proposes linking existing trails to local communities located at lower elevations adjacent to the Forest boundary. The alternatives considered in the plan maintain the use of the trail system, including the research and service trails; but alternatives 2 and 3 target the use of trails in the lower elevations and the integration of geographic region as part of the recreation opportunity considerations. All of the recreation operation and management of the trails within the Forest will apply the Forest Service Manual parameters (FSM 2353 and FSH 2309.18).

The recreation areas in the Forest are designed to limit effects to resources, and within a certain level of use, the effect on the soil resources should be minimal. The potential impacts will be higher during construction phases in developed recreational areas. The current recreational facilities are concentrated along the corridor of PR Road 191 North. These areas are deep inside the Forest boundary and away from local communities. The Forest Plan proposes a shift from Forest Service-driven management priorities to a more collaborative management strategy. This shift includes recreational options in the geographic region and are part of the considerations in alternatives 2 and 3 for the Forest Plan.

Roads can impact soil resources through exposure, compaction, shifts in natural runoff, and changes in functions and services by creating impervious surfaces. The 2014 Forest Plan Assessment for El Yunque Forest Plan includes 11.27 miles of inventoried, classified National Forest System roads in the Forest transportation inventory. Sixty percent are managed and maintained for public use with high clearance vehicles, 38 percent for low clearance vehicles, and 2 percent are unclassified roads. The unclassified roads include roads present when the land was acquired, or those created in order to access private properties, and many have been closed to public access by means of closure orders.

Dirt roads might be needed to accomplish research objectives, and standards are defined for this type of activity to reduce impacts in soil resources. Alternative 2 considers PR Road 186 as a scenic route to decentralize the recreation opportunities within the Forest and reduce crowding of the PR Road 191. The Forest Plan includes a goal of establishing a partnership with the municipal planners and other agencies to promote the official state designation of the PR Road 186 Scenic Byway.

Comparison of Alternatives

The alternatives included practices and standards to produce low to moderate soil disturbances. Alternative 1 includes a timber demonstration management area of 1,167 acres that has the potential to produce the highest soil disturbances. The timber demonstration activity includes management practices that will reduce the potential impacts. Alternative 1 also includes developed recreation areas (1,083 acres) and integrated management areas (6,225 acres), which are other zones where soil disturbances are documented. In alternatives 2 and 3 the timber demonstration, the developed recreation and the integrated management areas are eliminated and the community interface management area is considered for 7,187 acres in the lower elevations of the Forest. The activities considered in the community interface resource management area will result in fewer impacts than the ones considered in the timber demonstration area in alternative 1 because the proposed activities in the plan require the conservation of forested cover and the projects will be of a smaller scale. The designated areas (wilderness, research natural areas and wild and scenic recreation river corridors) are maintained in all three alternatives. El Verde Scenic Byway management area is considered in alternative 2 with an area of 697.3 acres that integrates PR Road 186

and the rights-of-way associated with the road. In alternative 3 El Verde Scenic Byway management area is considered under the community interface resource management area; but not a scenic byway.

The application of the best management practices, the appropriate mitigation actions, and a continuous monitoring plan would result in minimal soil effects for all the action alternatives.

Table 3-1. Acres of activities with potential soil impacts

Alternative	Activities and Management Areas	Acres
1	Timber Demonstration	1,167.0
	Develop Recreation Areas	1,083.0
	Integrated Management Areas	6,225.0
	Total	8,475.0
2	Community Interface Resource Management Area (CIRMA)	7,187.0
	El Verde Scenic Byway	697.3
	Total	7,884.3
3	Community Interface Resource Management Area (CIRMA)	7,884.3

Cumulative Effects

Soil productivity will likely be affected by an increase in hurricane intensity, which might exacerbate vegetation loss and surface disturbance. The conservation of the hydric soils and zones over 600 meters of elevation established a protection parameter to El Yunque's most sensitive soils. The management activities and areas considered in alternatives 2 and 3 redirect the recreational activities concentrated in the PR Road 191 corridor to other areas that with less sensitive slopes, soils, and natural conditions. The integration of the regional management areas and the incorporation of communities in the lower elevations of the Forest should reduce the pressure to the sensitive areas of the Forest.

The cumulative and environmental impacts of the proposed activities in the plan would be minimized for all the alternatives through the application of best management practices and the monitoring plan. The potential impacts in soils would be low for the alternatives 2 and 3 and from low to moderate in alternative 1. The overall cumulative effects of the management actions over time are not expected to reduce soil productivity.

3.3.2 Geology

3.3.2.1 Introduction

The geologic parent materials of El Yunque National Forest areas are of three basic types.

- Marine-deposited Cretaceous volcanic rocks, which are the most widespread.
- Tertiary intrusive quartz diorites, which occur on the south side of the Forest.
- Quaternary unconsolidated alluvial deposits (sands, gravels, silts and clays) occurring along major water courses.

The elevations on the Forest range from 100 feet (30.5 meters) at the northern boundary to 3,533 feet (1,077 meters) at El Toro Peak. The terrain ranges from gentle slopes in lower elevations to rugged side slopes exceeding 60 percent in higher elevations, where vertical rock-faced cliffs are numerous.

Mineral rights on the Forest that are former Spanish Crown Lands, are held by the Federal Government, and are not subject to U.S. mining laws. Opening these lands to mineral entry would require an act of Congress or a presidential decision (USDI Bureau of Mines 1991).

Ownership of mineral rights on the remainder of the Forest is more complicated. These rights were transferred from the Commonwealth of Puerto Rico to the Federal Government by Puerto Rican Law of February 16, 1903 (Puerto Rico Department of Natural Resources 1976). However, U.S. law states that acceptance of jurisdiction by the Federal Government is not automatic for lands acquired after 1940. Rights on such lands may be claimed by the Commonwealth of Puerto Rico through the U.S. Secretary of Interior. Puerto Rican law does not recognize private mineral rights, except for "non-commercial minerals" (equivalent to salable minerals under U.S. regulations [sand, clay, grave, etc.]) on private land.

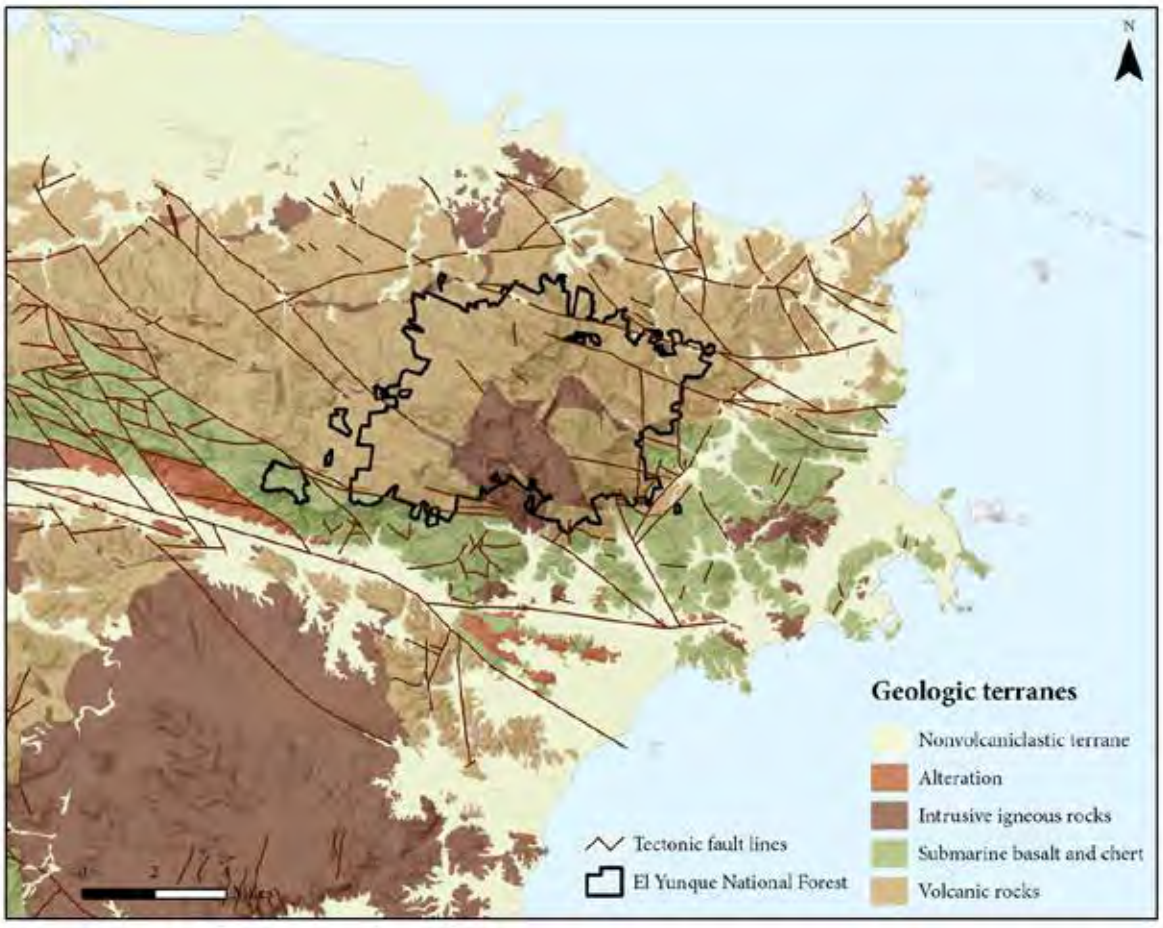
3.3.2.2 Affected Environment

The extraction and removal of mineral materials is the only management activity that has the potential to affect the geology of the area. El Yunque National Forest has no mineral activity and no outstanding mineral rights. Mineral management would not vary by alternative. The only salable mineral extraction that would be permitted would be incidental amounts for administrative uses; like cleaning the debris from landslides in the road system of the Forest. The application of best management practices and standards for the different management areas will provide the protection and parameters for this type of activity.

Geological Hazards

Puerto Rico is located on a microplate sandwiched between the obliquely subducting North American and Caribbean plates (map 3-4).

On average, Puerto Rico is strongly shaken with Modified Mercalli Intensity (MMI) >VII once every 100 years, and MMI >VI is experienced on the island once every 50 years.



Map 3-4. Map of northeastern Puerto Rico, showing major tectonic structures and approximate locations for damaging earthquakes in recent history

All Alternatives

The extraction and removal of mineral materials is the only management activity that has the potential to affect the geology of the area. El Yunque National Forest has no mineral activity and no outstanding mineral rights. Mineral management would not vary by alternative. The only salable mineral extraction that would be permitted would be incidental amounts for administrative uses; like cleaning the debris from landslides in the road system of the Forest. The application of best management practices and the standards for the different management areas will provide the protection and parameters for this type of activity.

The potential for indirect effects can be considered from earthquakes and those can include landslides and damages in electrical lines, communication sites and other infrastructure in the Forest.

Cumulative Effects

The cumulative effects analysis considered the management activities on the Forest in relation to adjacent areas that include roads, trail and communication sites. Management activities in El Yunque National Forest should not affect geological resources of the Forest or the regions established for alternatives 2 and 3. Some of the previous activities on the Forest and adjacent areas may have a reduced degree of effect on geologic resources like the development of the communication sites and the development of roads and

trails with rocks and other materials. The areas modified by these previous activities have adjusted and no effects are reported in these areas. The considered management criteria for the communication sites and other management areas are not expected to cause any cumulative or significant effect on the mineral resources of the Forest.

3.3.3 Air Quality

3.3.3.1 Affected Environment

El Yunque National Forest does not conduct any management activities that would adversely impact air quality. Because of the climate and environmental settings, activities such as prescribed burning and related events are not a concern for the air quality of the Forest. The locality of El Yunque at the north east of Puerto Rico presents an excellent opportunity for monitoring the trade winds that flow mostly from the northeast toward the Island. Due to the changes in elevation within the Forest, there are vast differences in ecological settings because of the variation in rainfall, relative humidity, wind velocity, cloud cover, temperature, atmospheric saturation deficit, and solar radiation. Air quality directly affects plants, animal and fish habitat, and contributes to the scenic and recreational attributes of the Forest and nearby communities. Air is an essential resource of the Forest. In addition to being a physical resource, air is also an esthetic resource. The Forest's relatively cool clean air attracts many visitors, and is valued by local residents as well.

The air quality within the Forest was documented as in good condition in the 2014 Forest Plan Assessment (2014) although the Saharan air layers during the summer months have been recognized as a potential impact to the air quality of the Forest. The chemical characteristics of cloud water samples can be used to analyze the average concentrations of organic aerosols and inorganic aerosols, nitrogen and total nitrogen among others, and compare them to similar locations. Potential changes from current climate conditions are considered in other sections of the document. Maintaining air quality for a healthy and functional environment is an important component of the Forest Plan.

3.3.3.2 Environmental Consequences

For all the alternatives, the expected air quality effects from planned development and use of the Forest are temporary and limited. Effects include dust and vehicular emissions from potential facilities construction and maintenance, public travel on Forest roads, and smoke from picnic and camping activities. The alternatives would not vary in their effects on air quality. Alternative 1 includes the timber production demonstration management area and the developed recreation management areas that can be sources of temporary air quality changes in specific sites of the Forest. Alternatives 2 and 3 exclude the timber demonstration management area and include the community interface resource management area, which provides for sustainable use of Forest resources, but does not include a timber program. Alternatives 2 and 3 have a forest products program that provides some wood products. Alternative 2 includes a scenic byway management area along PR Road 186 that can contribute to temporary changes in air quality.

The expected use of the scenic byway will be through an existing road and the activities are not expected to degrade the air quality of the area. The monitoring plan is a key component in all the alternatives and will help to determine any variations form the prevailing conditions of the air quality. Alternatives 2 and 3 include designated geographic areas (alternative 2–A. Rio Grande/ Luquillo; B. Canóvanas/Juncos/Las Piedras/Naguabo and Humacao; C. Fajardo/Ceiba; alternative 3–A. Canovanas/Rio Grande/Luquillo and Fajardo B. Juncos/Las Piedras/Naguabo/Humacao and Ceiba); these are important to the air resources of the Forest. The prevailing good air quality provided by El Yunque National Forest is considered an aesthetic resource to the visitors and community around the Forest. The integration of the geographic

areas is recognition of the importance of the air resources and opens the opportunity for collaborative work to monitor and protect the air quality of the Forest.

The monitoring plan will link to the climate change parameters because future projections using the parallel climate model show a decrease in average easterly winds over the Greater Antilles for the coming century, but an increase elsewhere in the Caribbean (Angeles et al. 2010). All the alternatives include the research and monitoring component for the Saharan layers of dust. The observed sensitivities of the dust to changes in climate indicate that future climate change could drastically change the amount of dust reaching the Caribbean (Prospero and Lamb 2003).

Cumulative Effects

The 2014 Forest Plan Assessment documented that the air quality within the Forest is in good condition. There are some activities and conditions associated with visitor density patterns in some areas of the Forest such as vehicle concentration that can degrade the air quality in some areas. If the interest and demand of the recreational areas are clustered, a cumulative effect can be expected unless the density is distributed through different areas of the Forest.

The identification of Saharan air layers during the summer months has the potential to impact the air quality of the Forest (2014 Forest Plan Assessment). This, added to the projected impacts of climate change, needs to be considered in all the alternatives to evaluate the cumulative effects that these conditions can create in the Forest. The increase in temperature and the associated urban development closer to the Forest edges (Lewsey et al. 2004, Kelman and West 2009) can also become a cumulative effect to air quality in relation to recurrence and distribution of wildfire.

The proposed alternatives are not expected to trigger environmental and social effects in the Forest in any particular manner. The protection and sustainable use of the Forest established by the proposed alternatives will reduce some of the potential cumulative effects to air quality on the Forest. All the alternatives prioritize Forest protection which is an important principle to sustain and protect the air quality for the visitors, stakeholders and region.

3.3.4 Climate Change, Climate Trends, and Extreme Weather Events

Average temperatures in the Caribbean region have increased over the past 40 years (Uyarra et al. 2005). Around the Luquillo Mountains, a small increase in annual maximum and minimum temperatures has been detected in long-term (62 year) records (Waide et al. 2013). Scientists predict warming will continue at an accelerated pace (Intergovernmental Panel on Climate Change 2007); however, climate models vary in the degree of warming (table 3-2). Projected decreases in precipitation in the Caribbean suggest drier wet seasons, and even drier dry seasons (table 3-3) (Cashman et al. 2010). Increasing sea surface temperatures may lift the base altitude of cloud formation (Still et al. 1999) and alter atmospheric circulation patterns (Woollings and Blackburn 2012). Any change in the cloud base height will further reduce precipitation in El Yunque (Comarazamy and González 2011). Climate change may also affect the distribution patterns and concentrations of air pollutants through changing wind and precipitation patterns (Bytnerowicz 2007) as well as increased temperatures (Bedsworth 2012).

Table 3-2. Climate model projections for increases in temperature at end of century

Source	Spatial Extent	Projection
Scatena (1998)	Puerto Rico	+1.5 to +2.5 °C
Girvetz et al. (2009); Meehl et al. (2007)	Puerto Rico	+2.2 to +2.7 °C
Campbell et al. (2011)	Caribbean	+2 to +5 °C
Christensen et al. (2007) (IPCC)	Central America	+1.8 to +5 °C
Magrin et al. (2007) (IPCC)	Latin America	+1 to +7.5 °C

Table 3-3. Climate model projections for changes in precipitation at end of century

Source	Spatial Extent	Projection
Girvetz et al. 2009; Meehl et al. 2007	Puerto Rico	-10 to -30 percent annually
Campbell et al. 2011	Caribbean	-25 to -50 percent annually
Biasutti et al. 2012 (IPCC)	Caribbean	-30 percent in spring and summer
Magrin et al. 2007 (IPCC)	Latin America	-40 to +10 percent annually

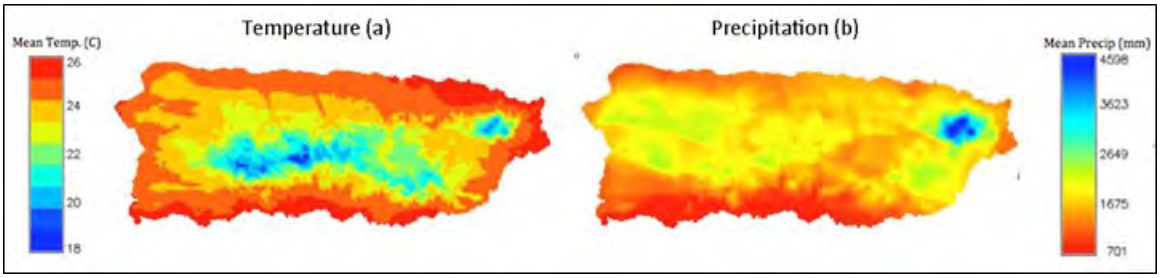


Figure 3-1. Spatial patterns of average annual temperature (a) and precipitation (b) from 1963–1995 based on historic observations

Source: (Daly et al. 2003)

3.3.4.1 Extreme Weather

Heavy rainfall events have become more common in Puerto Rico in recent years, particularly since 2009, with changes linked to high sea surface temperatures (Vélez Rodríguez and Votaw 2012). The frequency of extreme precipitation events is expected to continue to increase, leading to potential increases in inland flooding and landslides (Magrin et al. 2007; Seneviratne et al. 2012). Hurricane events are relatively common to the island of Puerto Rico, including the recent passing of Hurricanes Irma and Maria in 2017. It is projected that hurricanes are likely to become less frequent but more severe, with increased wind speeds, rainfall intensity, and storm surge height (Karl et al. 2009; Knutson et al. 2010; Goldenberg et al. 2001; Webster et al. 2005). In the Caribbean, the frequency of very warm days and nights is accelerating, while very cool days and nights are becoming less common (Peterson et al. 2002), increasing the likelihood of extreme heat waves (Anderson 2011). Additionally, as annual rainfall decreases over time in the Caribbean region, longer periods of drought are expected in the future (Breshears et al. 2005; Larsen 2000). In Puerto Rico, where nearly all wildfires are associated with human activity, the interactions between climate warming and drying and increased human development have the potential to increase the effects of fire (Robbins et al. 2008).

3.3.4.2 Terrestrial Ecosystems

Higher temperatures, changes in precipitation patterns, and any alteration in cloud cover will affect plant communities and ecosystem processes in El Yunque (Lasso and Ackerman 2003). Increasing night-time

temperatures may affect tropical tree growth and induce tree mortality (Clark et al. 2010; Wagner et al. 2012). Both intensified extreme weather events and progressively drier summer months in the Caribbean are expected to alter the distribution of tropical forest life-zones (Wunderle et al. 2011), potentially allowing low-elevation Tabonuco Forest species to colonize areas currently occupied by Palo Colorado Forest (Scatena 1998). Because they occur under narrowly defined environmental conditions, El Yunque's Cloud Forests are among the world's most sensitive ecosystems to climate change (Lasso and Ackerman 2003). Cloud Forest epiphytes (e.g., bromeliads) may experience moisture stress due to higher temperatures and less cloud cover with a rising cloud base, affecting epiphyte growth and flowering (Nadkarni and Solano 2002; Zotz and Bader 2009). Plant communities on isolated mountain peaks will be most vulnerable, as they will not be able to adapt to the shifting cloud base by moving to higher elevations (Laurance et al. 2011; Magrin et al. 2007).

As hurricanes increase in severity and intensity, the forest structure will continue to be altered (i.e. open canopy), which could lead to a shift in species composition and more vulnerable to invasive species. The combined effects of Hurricane Irma (2017) and Hurricane María (2017) were more intense than past Hurricane Hugo (1989) and Hurricane Georges (1998), resulting in more defoliation of the forest and an estimated average mortality of one in five trees. Hurricanes Irma and Maria caused severe defoliation, resulting in an almost completely open canopy. Palms and tree ferns were the few species that remained with some foliage immediately after the hurricanes. The strong winds resulted in many windthrown trees and broken branches, which have caused an altered forest structure of many branchless trees. Heavy rainfall has also caused many landslides throughout the forest, clearing away the vegetation and creating open areas that could be prone for invasive species colonization. Invasive species could also potentially spread because of the open canopy, as some species have been observed to spread beyond their usuall geographical distribution. After Hurricane Hugo, canopy openness returned to pre-Hurricane conditions within 14 months, and canopy openness in a hurricane mimicking experiment returned within 16 months (Klawinski, Dalton, & Shiels, 2014; Fernandez & Flether, 1991). It is anticipated that canopy openness will take longer after Hurricane María to return to pre-Hurricane conditions.

3.3.4.3 Aquatic Ecosystems

Shifts in rainfall patterns due to climate change will lead to periods of flooding and drought that can significantly affect aquatic ecosystems and water resources (Seager et al. 2009). Increases in heavy downpours in Puerto Rico and more intense hurricanes in the wet season can lead to increased erosion and sedimentation in waterways (Carpenter et al. 1992; Cashman et al. 2010; Karl et al. 2009). Riparian zones will see changes in structure and composition due to altered temperature, precipitation, and run-off regimes as well as changes in the distribution of plant and animal species (Seavy et al. 2009). Extended droughts in the dry season may significantly affect aquatic organisms by reducing dissolved oxygen content (Mulholland et al. 1997). During droughts, freshwater aquatic communities will experience crowding of species, leading to habitat squeezes and reduced reproductive output (Covich et al. 2003). In El Yunque streams, extended periods of extreme low water flows may increase pollutant concentrations and excessive nutrients (Cashman et al. 2010; Covich et al. 2003).

The recent passing of hurricanes Irma and Maria over El Yunque became stream forming events, as new stream formations were found quickly after hurricane Maria. While downed woody debris is positive for habitat and stream formation, landslides and other debris resulting from the hurricanes obstructed habitat connectivity. After the passing of these hurricanes, the greatest negative impacts from intial observations came from off forest areas due to lack of sanitation in communities, increased fecal coliforms and trash.

3.3.4.4 Wildlife

Climatic change may push the narrow thermal tolerances of many species in tropical environments above their upper limits (Huey et al. 2009; Laurance et al. 2011), prompting population losses and habitat changes that will affect animal communities (Blaustein et al. 2010). Because of their cool-adapted, range-restricted nature, high-elevation amphibians, including Puerto Rican coquí frogs, are especially vulnerable to future changes (Barker et al. 2011; Brodie et al. 2011; Longo et al. 2010; Stallard et al. 2001). More frequent drought conditions may increase the vulnerability of both reptiles and amphibians to water loss, parasites, and diseases including amphibian chytrid fungus (Anchukaitis and Evans 2010; Burrowes et al. 2004; Rogowitz 1996). Reduced rainfall may lead to decreased habitat quality for neo-tropical bird migrants wintering in El Yunque (Studs and Marra 2011), while cavity-nesting birds, including the Puerto Rican parrot (*Amazona vittata*), could see an increase in habitat competition and nesting predation with an increase in major hurricane disturbances (Arendt 2000; Pounds et al. 1999).

With the extent of the defoliation and canopy branching lost as a result of hurricanes Irma and Maria, which will create drier microclimate and lower prey availability, it is expected this will result in a decline in coqui abundance. Additionally, since the entire Forest was nearly completely defoliated, there is a reduction in refugia for wildlife and an expected reduction in fruit and seed availability for wildlife.

3.3.4.5 Recreation

The Caribbean region, where year-round warm weather is the principal tourism resource, may see increasing competition from other regions as warm seasons expand globally (Scott et al. 2004). Sea level rise will affect coastal resorts, which may affect tourist and recreationist preferences throughout Puerto Rico (Lewsey et al. 2004; Magrin et al. 2007). Climate change may affect recreation in El Yunque through changes to local ecosystems and resources that affect scenic values, as well as changes to weather patterns that may disrupt recreational activities and lead to changes in visitor use (Prideaux et al. 2010). Visitors to El Yunque may see effects to the local plant and animal communities that make the Forest unique (Scatena 1998). An increase in extreme weather events may increase damage to facilities and structures, reduce tourist access in some areas, and increase the need for road repairs (Joyce et al. 2008). Recreation related infrastructure suffered significant damages after hurricanes Irma and María, including landslides or bed failures on trails, damaged picnic shelters, and damage to recreation related historic infrastructure. The collapse of the infrastructure also had severe impacts on the recreation offering and socioeconomic opportunities provided by the forest including lack of access for tourism, telecommunications and research.

3.3.5 Water and Watersheds

This section offers the information and findings of effects of the alternatives on the water resources and watersheds within El Yunque National Forest designated zones. The main public uses of the waters that drain from the Forest are as municipal and domestic water sources, and as recreational opportunities for the visitors and surrounding communities in natural pools and scenic waterfalls. The 2014 Forest Plan Assessment identifies the water used for public consumption as an important commodity with economic significance. In this section, the information on watersheds, rivers and streams; riparian zones, wetlands and water quantity; is considered for the proposed action and alternatives for the Forest Plan.

Water resources are jointly managed by several state and Federal agencies on the Island. Water quality is regulated by the Puerto Rico Environmental Quality Board and the Environmental Protection Agency. Water extraction is regulated by the Department of Natural and Environmental Resources, and water distribution and supply is managed by the Puerto Rico Aqueducts and Sewers Authority. Water quality and quantity (part of the Caribbean Water Science Center) is managed by the U.S. Geological Survey (USGS).

Ample information regarding the water resources of El Yunque National Forest, including instream flow data, is available and accessible in real time from the USGS and the other agencies mentioned above. The Forest protects the headwaters of eight watersheds which produce an estimated 73.5 billion gallons of water per year. The 2008 El Yunque National Forest Fiscal Year Monitoring and Evaluation Report presents a table of the conditions and trends of programmatic events associated with the desired future conditions of the Forest's current land management plan.

Table 3-4. Conditions and trends of the current land management plan toward the established desired future conditions

DFC	Measurement or management action	2003	2004	2005	2006	2008
Healthy Watershed	Acres restored	9	8	15	7	12
Healthy Watershed	Acres affected by illegal use	0	0	0	8	1.5
Balanced Water Use	Extraction	51 mgd	66.4 mgd	66.4 mgd	66.4 mgd	66.4 mgd
Balanced Water Use	Intakes	32	34	36	36	36
Dynamic Links	Flows	Not below natural minimum	Not below natural minimum	Not below natural minimum	Not below natural minimum	Not below natural minimum
Plan Goals	Number of programmatic events	6	8	8	7	3

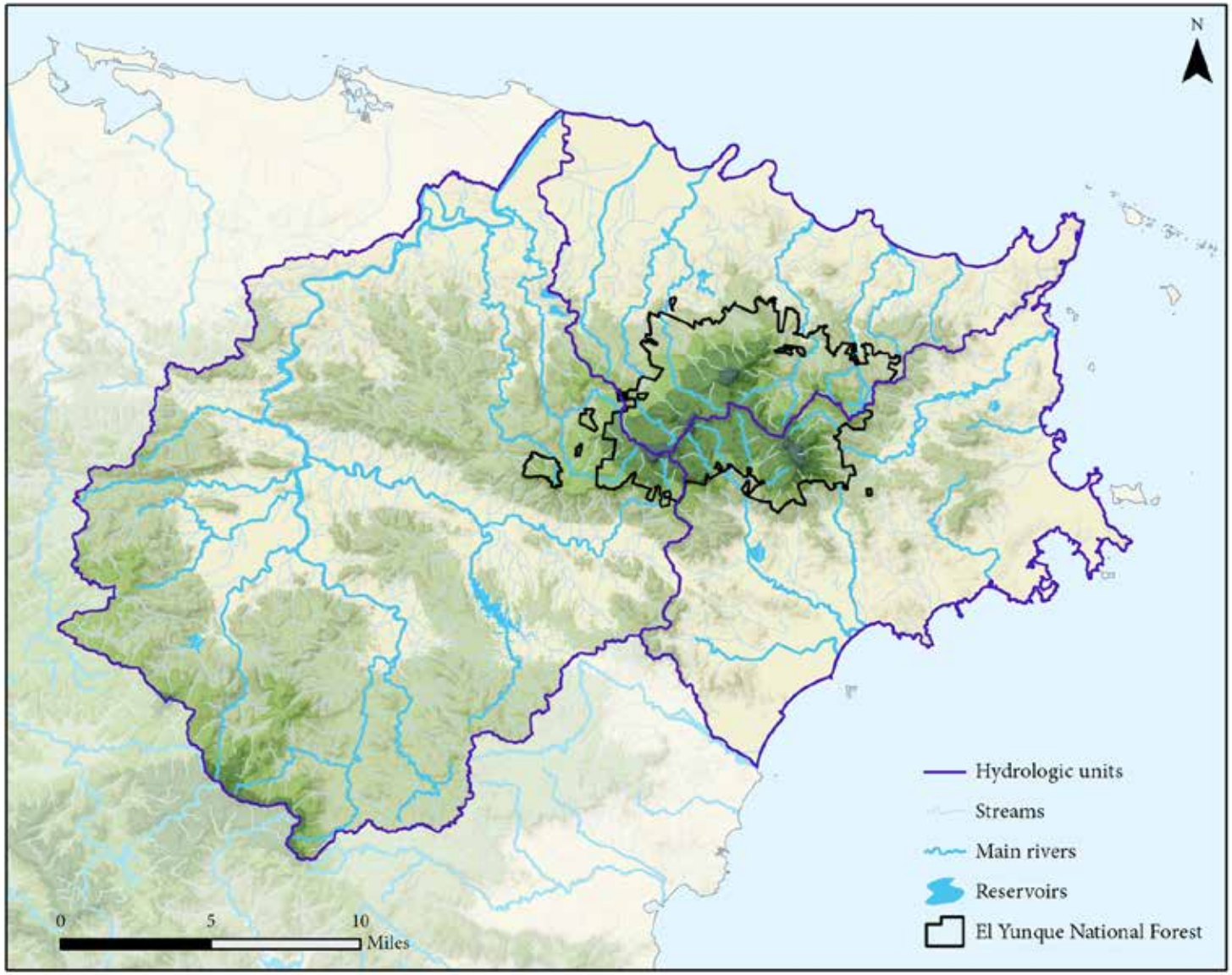
3.3.5.1 Affected Environment: Watersheds

Conditions and Trends of the Current Land Management Plan Moving Toward the Desired Future Conditions

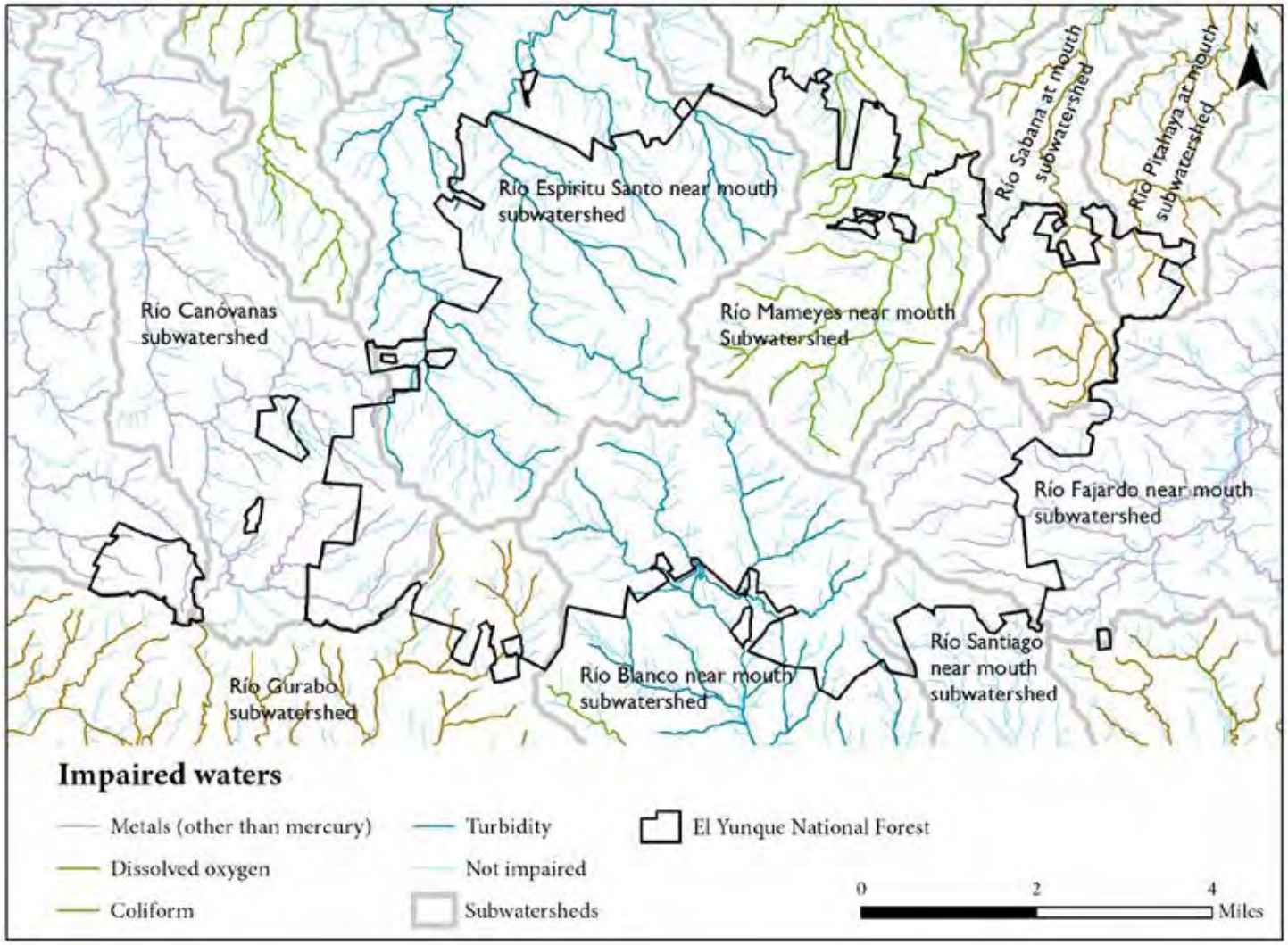
The watersheds within the designated areas of El Yunque are classified and defined by the hydrologic unit codes (HUCs) (http://pr.water.usgs.gov/public/rt/pr/rtmap_pr_east.html) that classify watersheds by size from region to sub-watersheds. Puerto Rico and other outlying Caribbean areas are in region 21. Table 3-5 includes the HUCs numbers, names, extents, and percent under Forest Service ownership for each watershed identified according to El Yunque Watershed Condition Classification Supplemental Guidance (USDA Forest Service 2010; EIY 2010 WCC Reg Supp v.5).

Table 3-5. Hydrologic units within the project area

HUC Number	Name	Total Acres	Percent of Acres under Forest Service Ownership
210100050202	Rio Blanco near mouth	17,341	30
210100050203	Rio Santiago near mouth	4,381	12
210100050204	Rio Fajardo near mouth	16,628	17
210100050302	Rio Pitahaya at mouth	4,085	11
210100050303	Rio Sabana at mouth	4,616	42
210100050304	Rio Mameyes near mouth	9,950	52
210100050305	Rio Espiritu Santo near mouth	15,761	55
210100050413	Rio Canóvanas/within RGLoiza	11,209	14



Map 3-5. Spatial relationship among watersheds, El Yunque



Map 3-6. El Yunque National Forest impaired and non-impaired waterbodies

3.3.5.2 Affected Environment: Rivers and Streams

The stream flows of the hydrologic network within the Forest are highly variable, running very high during heavy rains and much lower during periods of low rainfall. Stream water is generally clear, with low accumulations of dissolved nutrients at low flows, and turbid during high flows. The steep drainage of the eight watersheds is formed by volcanoclastic and igneous rocks that exert a strong, localized lithologic influence on the stream channels. The rivers of El Yunque are known for their biodiversity and conservation management in the surrounding watersheds. Mameyes River, as one of the last undammed rivers in Puerto Rico that originates on El Yunque, can be used as a reference stream to estimate the natural range of variance for El Yunque aquatic ecosystems.

The longitudinal profiles of the rivers are influenced by the multiple rocks types; coarse sediments are delivered by landslides along steep hillslopes (greater than 12 degrees) to the channels and also may influence channel gradients and geometry (Pike 2008). Río la Mina, Río Mameyes and a tributary; and the Río Icacos, a tributary of the Río Blanco are designated as wild and scenic rivers (National Park Service 2005).

Monthly water budgets show that higher rainfall occurs from August to December, with a rainfall peak in November. A rainfall peak also occurs in May. March is the driest month of the year, which has important management implications: water diversion for human use should not exceed a level that would cause unacceptable stream habitat degradation during March. Runoff volume follows the monthly rainfall pattern: streamflow peaks in November with a second peak in May and is lowest in March.

The parameters in the watershed condition framework are presented in table 3-6. These parameters were considered and analyzed for the Plan alternatives considering short- (1 to 10 years) and long-term (1 to 50 years) scenarios in the Blanco, Canóvanas, Espíritu Santo, Fajardo, Mameyes, Pitahaya, Sabana and Santiago watersheds.

Table 3-6. Watershed condition framework parameters analyzed in this Plan

Key Attribute Name	Measure
Hydrologic Function	Flow Characteristics
Water Quality Sediments	Forest Coverage Rating
Water Quality Sediments	Riparian Road Density
Water Quality Sediments	Road Density Rating
Water Quality Sediments	Road Maintenance Index
Water Quality Toxics	Impaired Water Listed as 303D
Water Quality Toxics	Water Quality Problem (not 303D listed)

The need of a standardized regional approach for ecological and biological planning for the forest planning process was the main reason to develop a collaborative initiative to create what is known as the ecological sustainability evaluation (ESE) tool. The ESE tool is a strategic conservation planning tool used by the Forest Service Southern Region for forest planning. Ecological systems, watersheds, terrestrial and aquatic species are carried through the preliminary assessment and sustainability framework (including strategies and plan alternatives) to ascertain expected outcomes. The tool utilizes a standardized process while being flexible, efficient, and adaptable to Forest-specific priorities and needs. The ESE tool uses prioritization algorithms utilizing rank, importance rating, key characteristics and indicators, stresses and threats, scope and severity ratings, and management opportunities to assist and

support management decisions while creating a standardized, credible, and defensible process record. The ecological sustainability evaluation tool analysis also considered the short-term (1 to 10 years) and long-term (1 to 50 years) scenarios in the Forest.

The Forest's streams are considered high quality waters that constitute an exceptional resource (Environmental Quality Board 1990). Generally, the water meets or exceeds Commonwealth water quality standards. Fecal coliform limits are being exceeded at heavily used undeveloped recreation sites, such as Puente Roto.

The Puerto Rico Aqueduct and Sewer Authority (PRASA) operate 12 dams on the Forest, diverting stream water to treatment plants to provide municipal water. These systems consist of low concrete dams (less than 6 feet in height), simple passive intake structures, and buried pipelines carrying the water to off-Forest treatment plants where sediments are removed and the water is chlorinated. In addition to public use of Forest water through PRASA's facilities, 36 private families obtain their domestic water from the Forest. These families use smaller dams (no more than 3 feet height) combined with 1- to 2-inch pipes.

3.3.5.3 Environmental Consequences: Rivers and Streams

All Alternatives

None of the alternatives considered for the Forest Plan would have any measurable effect on the amount of water produced by the Forest. Direct effects are caused by an action and occur at the same time and place, whereas indirect effects are caused by the action, but manifested later in time or farther removed in distance (but are generally foreseeable) (CEQ regulations Section 1508.8). For all alternatives, management activities on National Forest System land, and continued growth and development on private land have the potential for direct and indirect impacts to rivers and streams.

The Forest Plan proposes management to meet Forest land management objectives and move towards desired conditions. Effects are disclosed in general terms with estimations of "probable" effects. Direct and indirect effects would occur at the project level (where implementation occurs), where the effects are specific for an action where data related to that action and Forest monitoring is available.

For all the Plan alternatives the continuing urbanization and increase in construction in the areas around the Forest can increase the expansion of "urban-forest interfaces" or "wildland-urban interfaces" (Radeloff et al. 2005). The watershed condition framework and the ecological sustainability evaluation tool analysis identified the following:

- The Rio Blanco Watershed is a priority watershed.
- The impacts in all the watersheds and river system will be more relevant for each alternative in the long-term scenarios. For alternative 1 the watersheds and hydrologic network will show less favorable conditions compared to alternative 2 and 3.
- Five watersheds were rated as "very good" in the planning area for all the alternatives and time scenarios. This indicates that the watershed conditions are optimal; and that associated species' populations should remain robust and potentially even expand.
- Three watersheds (Rio Mameyes, Rio Espiritu Santo and Rio Blanco) were rated "good" which indicates that conditions are acceptable and that associated species' populations should remain stable.
- Watershed conditions remain in a sustainable level or improve in the long-term scenarios in alternatives 2 and 3.
- The application of best management practices should eliminate the long-term effects and indirect impacts to rivers for all the alternatives.

Alternative 1

This alternative preserves the management strategies of the 1997 Forest Land and Resource Management Plan. Under the 1997 Plan the information and application of the watershed condition framework was not applied, reducing the opportunity to categorize priority watershed according to their ecological and physical conditions. The consideration of an "all-lands" strategy that could produce adoption or collaborative management programs for creeks and rivers was not considered under the management strategies in the 1997 Plan, reducing the potential benefits of monitoring components for rivers and watersheds through community and environmental organization agreements.

Alternatives 2 and 3

Alternatives 2 and 3 present similar conditions of long-term improvements and sustaining the conditions of the rivers and watersheds. The alternatives identified priority watersheds for improvement following completion of the watershed condition framework. Collaborative and cooperative agreements with communities and environmental organizations provide a regional management perspective for the rivers and watersheds that starts within the Forest, but can continue through private properties resulting in a complete watershed approach. The themes in the Forest Plan show the need to maintain a healthy, accessible, and sustainable Forest and provide economic, ecological and social opportunities through an inclusive and collaborative Forest management approach. Alternative 1 does not provide specific plan components that could benefit the long-term sustainability of the watershed. The no action in view of the uses and practices in the road next to Rio Espiritu Santo of the areas considered in the analysis present a reduction in the watershed sustainability. Alternative 2 considers the integration of the scenic byway of road PR Road 186 but it also includes a plan component for environmental education, collaboration and ecosystem services. The establishment of the CIRMA in Alternative 2 without the necessary management applications can represent a reduction of the watershed sustainability. Although the NEPA process is expected to occur before any project is implemented, Alternative 2 has management practices and strategies (such as collaboration and environmental education) for the conservation and recovery of the ecosystems, as well as management strategies that would assist in its protection. However, alternative 3 provides a better scenario for the Rio Espiritu Santo Watershed in the long term (see figure 3-2) because it did not consider a scenic byway management area but did not provide the option of an expanded educational component that is required for an integrated watershed conservation strategy. Both alternatives 2 and 3 maintain the quality of the Rio Espiritu Santo Watershed in the short-term scenario. Activities associated with the scenic byway in PR Road 186 will provide additional benefits to the Forest and further management considerations.

Under alternatives 2 and 3 the geographic areas concept provides a better distribution and association of the municipalities in which the watersheds are defined and can provide for a stronger community interaction in watershed approaches and programs. Alternative 2 considers the geographic areas and provides the integration of watershed management for the Fajardo and Ceiba area which is the main water supply watershed for the municipalities to the north of the Forest.

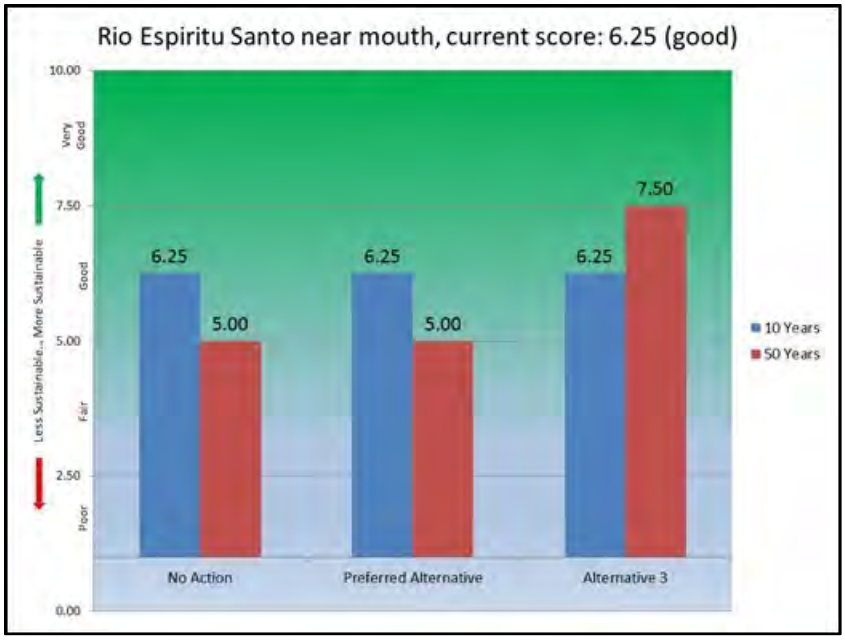


Figure 3-2. Expected outcomes by alternative for the Rio Espiritu Santo Watershed

Cumulative Effects: Rivers and Streams

The cumulative effects analysis considers the eight HUCs identified in region of Puerto Rico (Region 21) as displayed earlier in affected environment; the temporal timeframe is the life of the plan. The Forest accounts for about 31.4 percent of the total area that composes the watersheds within the designated boundary. Past actions that have influenced the current condition include the approval of facilities near or close to a river or stream. Foreseeable actions on State, private or other Federal lands include the changes in zoning or land use that can occur in the municipalities that border the Forest and are outside of Forest Service control.

In no action (alternative 1) when these actions are considered with the management plan that has been in place since 1997, the cumulative impacts throughout the rivers that flow from the Forest include the considerations of additional recreational areas, the timber demonstration projects and a management perspective based on management activities in the rivers and stream within the Forest boundaries. The construction of housing projects, the development of rural landscapes and urbanization on private lands adjacent to the Forest can create cumulative impacts.

In alternative 2 and 3 although cumulative impacts would be possible from the development of rural landscape, the effects could be reduced with the "all-lands" approach and the integration of a regional management perspective. Jennings et al. (2014) documents that tropical landcover change, resulting from direct human activities, interacts with anthropogenic ecosystem drivers such as climate change and affects watershed supply. The scenic byway considered in alternative 2 is a use that would represent potential cumulative effects in the Rio Espiritu Santo Watershed. The use of an existing road (PR 186) for the scenic byway section would also represent the potential maintenance and drainage improvements that could reduce cumulative impacts associated with the no action (alternative 1) option. The consideration of recreational facilities or the development of recreational trails could have cumulative impacts depending of their location. It is important to note that most visitors enjoy or find pleasing contact with and use of the rivers and streams in El Yunque. In alternative 2 and 3 the proposed trails associated with the river course would need special attention because of the cumulative impacts expected from these activities.

3.3.5.4 Affected Environment: Riparian Zones

The plan considers the restoration and conservation of riparian zones with native species to sustain its diversity and functions. All the alternatives recognize that the riparian zones deliver ecological services to the aquatic ecosystems and watersheds of El Yunque and the surrounding regional lands. As part of the 2014 Forest Plan Assessment, 100-foot (30.5 meters) buffer zones were placed around the rivers (National Hydrography Dataset) inside the Forest to estimate riparian forests. The buffer zones were separated into submontane moist, montane wet and rain, and montane cloud wet and rain riparian forests using a combination of ecological life zones data and the 600-meter elevation line. These river buffer zones integrate 2,113.83 acres. Table 3-7 shows the distribution of acres per zone in the Forest. The 2014 Forest Plan Assessment presents a description of the vegetation described by different studies in these zones (Heartsill-Scalley et al. 2007; Brown et al. 2006; Pike and Scatena 2009; Scatena 1990; O'Connor et al. 2000; Scatena and Larsen 1990).

Table 3-7. River buffer zones in the planning area

River Buffer Zone	Area in Acres
Submontane Moist	58.96
Montane Wet and Rain	1,350.14
Montane Cloud Wet and Rain	704.73

Source: 2014 Forest Plan Assessment, El Yunque National Forest

The Forest plan recognizes the need of a survey in the riparian zones and defines standards and guidelines to achieve the goal of maintaining or improve the functional ecological connections provided by riparian zones through the management regions.

The Forest plan recognizes that hurricanes Maria and Irma were both stream forming events that resulted in a large quanity of sediment, rocky substrate, and large woody debris added to the riparian zones. These recent changes are part of the natural disturbance cycle and contribute to maintaining the health of the riparian zones.

3.3.5.5 Environmental Consequences: Riparian Zones

All Alternatives

All alternatives would emphasize protection and improvement of riparian zones. Management activities consistent with best management practices and standards and guidelines will be implemented as described in the 2014 Forest Plan Assessment. For the estimated score in the ecological sustainability evaluation tool, watershed improvement varies by alternatives. Alternatives 2 and 3 present a better score for Rio Mameyes, Rio Espiritu Santo, and Rio Canóvanas in the long-term scenarios.

Alternatives 2 and 3 emphasize the collaborative approaches for conservation education regarding aquatic ecosystems or a related ecosystem component for the priority watershed every 2 years to enhance public awareness and opportunities and to better understand scientific land management. These alternatives also encourage the collaborative agreements with communities, agencies, and environmental organizations to establish permanent plots in order to monitor environmental change and its effect to El Yunque wetlands and the broader landscape. Alternative 1 presents conservation approaches for the riparian zones, but does not provide specific direction or management strategies for improvement and does not establish priority watersheds for the Forest. The riparian and watershed composition and structure are key components of aquatic ecosystems and are, therefore, important components of aquatic ecosystems monitoring.

Alternative 1

This alternative follows the management strategy of the 1997 Forest Land and Resource Management Plan which follows a similar delineation of the riparian zone (100-foot buffer) used for the 2014 Forest Plan Assessment. The alternative includes the development of recreational areas with construction intended to reduce sedimentation to conserve riparian zones. The 1997 Plan includes a timber harvest component that is identified as a sediment source action in the long-term scenario of the Plan. The alternative does not integrate the evaluation of the watershed condition framework and did not establish a priority watershed as part of the analysis. Alternative 1 does not consider the geographical zones considered in alternatives 2 and 3, where there is the potential integration of community groups and organizations to participate in management strategies applied to riparian zones.

Alternatives 2 and 3

In alternatives 2 and 3, the watershed condition framework identified one priority watershed for improvements in the short-term scenario of the Plan. The watershed condition framework identified the Rio Blanco watershed as the highest priority for improvement within the Forest. This watershed will be managed to supply appropriate ecological services.

The identification of geographic areas in these alternatives also provides opportunities for targeted conservation initiatives, such as for stream corridors, riparian zones, wild and scenic river corridors, and potential riparian conservation connection projects with other naturally protected areas in the regions like the Corredor Ecólogico del Noreste Natural Reserve. Alternative 2 includes a geographic area that covers the eastern municipalities of Fajardo and Ceiba which specifically establish management emphasis in watershed management. This geographic area could be used as a reference for watershed integrated management initiatives developed in collaboration with eastern municipalities. Alternatives 2 and 3 promote the engagement of community-based enterprises, groups, and other organizations for rivers, floodplains, and riparian area restoration and conservation efforts. The riparian management zones are defined in these alternatives as 100 feet from the edges unless a site-specific analysis is conducted to identify and delineate a more specific riparian management zone. Standards and guidelines require the use of best management practices approved by the Forest Service for all management activities or maintenance practices proposed close to riparian zones.

Cumulative Effects

The cumulative effects for El Yunque National Forest were determined using current information provided in the 2014 Forest Plan Assessment, existing data, past practices, identified project effects and the available information on private land actions. The ecological sustainability evaluation tool analysis indicated the possible results for both 10 and 50 year time frames for alternative 2 and 3. These results are not significantly different and neither alternative resulted in long-term impacts due to current list of proposed actions. Alternative 1 presented less improvement in the watershed conditions compared to the other alternatives in three watersheds. Because of its relatively high road density and the anticipated future maintenance of roads and trails in each alternative, the Río Fajardo Watershed moved from very good to fair condition for all alternatives. Alternative 2 best addresses this condition shift by focusing on suitanable maintenance to minimize impacts to riparian zones.

Although the physical settings of the Rio Fajardo Watershed within the Forest limits display conditions that present positive sceneries; other areas of the watershed show dynamics of land uses that influence the quality conditions of the watershed. The management strategies considered for the Plan alternatives in the Rio Fajardo Watershed could maintain its quality within the Forest limits, but an integrated watershed management strategy will be needed to improve the overall watershed conditions in a long-term perspective. This circumstance is exhibited in the estimated watershed score as part of the analysis

applied and will be considered as part of the regional management perspective considered in the management plan. The graph presented in figure 3-3 display a constant conduct for this watershed but it also displays the need of long-term management strategies that will require a joined cohesive management project to improve the water quality of the Rio Fajardo watershed.

Summary of Effects, All Alternatives

All alternatives would emphasize protecting and improving riparian zones. Management activities consistent with best management practices and standards and guidelines will be implemented as described in the 2014 Forest Plan Assessment. The estimated score in the ecological sustainability evaluation tool for watershed improvement varies by alternatives. Alternatives 2 and 3 present a better score for Rio Mameyes, Rio Espiritu Santo and Rio Canóvanas in the long-term scenarios.

Alternatives 2 and 3 emphasize the collaborative approaches for conservation education regarding aquatic ecosystems or a related ecosystem component for the priority watershed every 2 years to enhance public awareness and opportunities and to better understand scientific land management. These alternatives also encourage collaborative agreements with communities, agencies and environmental organizations to establish permanent plots in order to monitor environmental change and its effect to El Yunque wetlands and the broader landscape. Alternative 1 presents conservation approaches for the riparian zones, but did not provide specific direction or management strategies for improvement and did not establish priority watersheds for the Forest. The riparian and watershed composition and structure are key components of aquatic ecosystems and are, therefore, important components of aquatic ecosystems monitoring.

3.3.5.6 Affected Environment: Water Quality and Quantity

The 2014 Forest Plan Assessment describes the importance of the water resources produced in the Luquillo Mountains. The Luquillo Mountains supply more than 20 percent of the Island's municipal water each year, with El Yunque providing an average of 276 cubic hectometers of water per year for municipal uses (Scatena and Johnson 2001). The rivers that drain the Luquillo Experimental Forest all have steep gradients, boulder- and bedrock-lined channels with steep-pool morphology, and waterfalls (Ahmad et al. 1993). The yearly water production of El Yunque is estimated at 73.5 billion gallons per year ([LRMP] USDA Forest Service 1997). Estimated as the cost paid by the consumer, water extracted from the streams that drain the Luquillo Mountains is worth about $25 million per year. Because of the importance of understanding where the water is most available and how the quantity changes; with individual storms, season, and on annual to decadal time scales; water budgets have been developed for El Yunque National Forest.

Water quality in the watersheds of El Yunque is relatively pure. According to McDowell (1994), water chemistry data indicate that major cations and anion concentrations do not exceed water quality standards. El Yunque common aquatic species include the following: nine freshwater shrimp species (*Xiphocaris elongata*, *Atya scabra*, *Atya lanipes, Atya innocuous, Micratya poeyi*, *Macrobrachium faustinum*, *Macrobrachium heterchirus*, *Macrobrachium carcinus*, and *Macrobrachium crenulatum*), one crab species (*Epilobocera sinuatifrons*), and five fish species (*Sicydium plumieri*, *Awaous banana*, *Agonostomus monticola*, *Anguilla rostrata*, and *Gobiomorus dormitor*). There are no rare or federally listed aquatic species on El Yunque.

Population trends developed from long-term monitoring sites in many of the watersheds show a stable count of common aquatic species on El Yunque. Many of the freshwater shrimp live their entire life cycle within El Yunque river systems. The river system defined for the watershed condition framework connects with coastal areas that integrate an estuary ecosystem, which provides an important condition and habitat for El Yunque aquatic species. Endemic freshwater fishes have the same biological cycle, except the American eel (*Anguilla rostrata*). The American eel is a catadromous fish species, where adults

travel to breeding areas in the Sargasso Sea to the north and the next generation of young eels return to El Yunque streams.

Primary impacts of the Forest from pollution are associated with public use of pools and river segments as recreational areas and from sediments produced by landslides in the Forest. A pulse of 250 landslides along roads occurred with hurricanes Irma and Maria which is excpected to continue to contribute sediment until the landslides stabilize in the future. Some impacts from airborne pollutants have been found in the waters (Jennings et al. 2014) of some watersheds. These are periodic events but have been identified as important monitoring components of the effects of climate change on El Yunque. There are 34 water intakes withdrawing over 46 million gallons per day from the Forest, in some basins, up to 82 percent of the median flow is diverted. Currently, 70 percent of water generated within the Forest is diverted before reaching the ocean, up from 54 percent in 1994 (Crook et al. 2007). The Plan considers improvement of the stream water network information to evaluate the quality and supply parameters of the resources. The management strategy will be developed considering an outreach component to promote the value and influence of the resource in relation to the socioeconomic system or aspects of the region.

3.3.5.7 Environmental Consequences: Water Quality

Effects Common to All Alternatives

Water quality and quantity were identified as key services provided by the Forest and should be maintained or improved as part of the management actions considered. The use of water for human consumption has to be balanced with in-stream flow needs for use, recreation, research, and aquatic and terrestrial ecosystem maintenance. Integrating a watershed management perspective, the Forest should conserve a functional linkage for the aquatic wildlife from inside the Forest to the ocean. Alternative 2 and 3 consider the watershed management approach and apply the watershed condition framework as part of the analysis for the management strategies. All the alternatives consider the conservation and application of best management practices applicable for water resource protection. The watershed approach considered with the geographic zones in the Forest plan will serve to minimize potential pollution problems and improve the restoration and monitoring strategies throughout the Forest.

All the alternatives established that no management practice may cause detrimental changes in water quality and chemical composition, or block the watercourse or deposit sediment that would adversely affect the water conditions and fish habitat. The Plan considers key ecosystem characteristic related to drought, measured by drought severity indices and trends (from U.S. Geological Survey), which would be monitored over time as the data is updated through the water resource strategies applied in the Forest Plan.

Alternative 1

Alternative 1 follows the 1997 Revised Land and Resource Management Plan which provide standards and guidelines to maintain a conservation track for the water resources of the Forest. This alternative does not establish a watershed approach with the definition of priorities and the analysis provided by the watershed condition framework. The application of management practices with this alternative will be focused within the Forest boundaries which can limit the management effectiveness for aquatic species.

Alternatives 2 and 3

These alternatives present similar conservation strategies for water resources. Improving or conserving water quality is achieved in both alternatives. The strategy of working with partners and/or other agencies to establish environmental flow ranges based on an empirical Forest water budget is proposed in both alternatives, but alternative 2 provides the integration of geographical areas that should provide additional

opportunities for partnerships. The integration of the geographical region could develop projects for specific watersheds, like the one that drains toward Northeast Ecological Corridor establishing a transboundary conservation initiative from Federal property to state and private areas to improve the management of aquatic ecosystems. The application of the watershed condition framework will provide a conservation strategy starting with the Rio Blanco Watershed that was identified as a priority watershed. The alternatives protect surface and sub-surface water resources from physical, chemical, and biological pollutants, and eliminate modifying flow regimes to levels that affect the abiotic functions and biotic needs for viable population in the aquatic ecosystems of the Forest.

Water Quality and Quantity Cumulative Effects

The Forest accounts for about 31.4 percent of the total area that compose the watersheds within the designated boundary. Past actions that have influenced the current condition include the approval of facilities near or close to a river or stream. Hurricanes Irma and Maria have resulted in increased contaminants from private and other lands outside Forest boundaries. Foreseeable actions on State, private or other Federal lands include the changes in zoning or land use that can occur in the municipalities that border the Forest and are outside of Forest Service control. Climate change is likely to amplify existing pressures on water resources and water availability in northeastern Puerto Rico, especially in combination with increased urban development and water extraction (Crook and others 2007). The quality of water would also show the cumulative effects of climate change because extended periods of extreme low flows in the dry season may result in increased pollutant concentrations and excessive nutrients in Caribbean streams (Cashman et al. 2010; Covich et al. 2003).

In no action (Alternative 1) these actions are considered within the management plan that has been in place since 1997. Although cumulative impacts would be possible form the development of rural landscape, in Alternative 1 and 2 the effects could be reduced with the "all-lands" approach and the integration of a regional management perspective. Considering climate change, it can be expected that more intense rainfall events lead to increased runoff in the wet season; these events can also lead to decreased water quality through increased turbidity and erosion as well as flooding (Cashman et al. 2010). Watersheds that respond quickly to precipitation, such as in the Luquillo Mountains, may be especially affected (Schellekens et al. 2000). The scenic byway proposed in alternative 2 could have potential cumulative effects in the Rio Espiritu Santo Watershed. The use of an existing road (PR 186) for the scenic byway section would also represent the potential maintenance and drainage improvements that could reduce cumulative impacts associated with the no action (alternative 1) option. This maintenance is important in the consideration of cumulative effects considering climate change because an increase in extreme weather events may increase damage to facilities and structures, reduce tourist access in some areas, and increase the need for road repairs (Joyce et al. 2008).

3.3.5.8 Watershed Health: Watershed Condition Framework

The watersheds identified in El Yunque were analyzed using the watershed condition framework (WCF) that evaluated watershed conditions based on watershed characteristics and attributes. Through the WCF, the watershed health is evaluated to establish priority watersheds that require restoration. The WCF classifies watershed condition, develops restoration in priority watersheds, and monitors accomplishments (USDA Forest Service 2011a, 2011b, 2011c). The WCF classified all the watersheds within the planning area as "good" or "very good" (the tables are included in the administrative record). The Plan establishes that the Forest will proceed with the application of the watershed condition framework according to the restoration action plans.

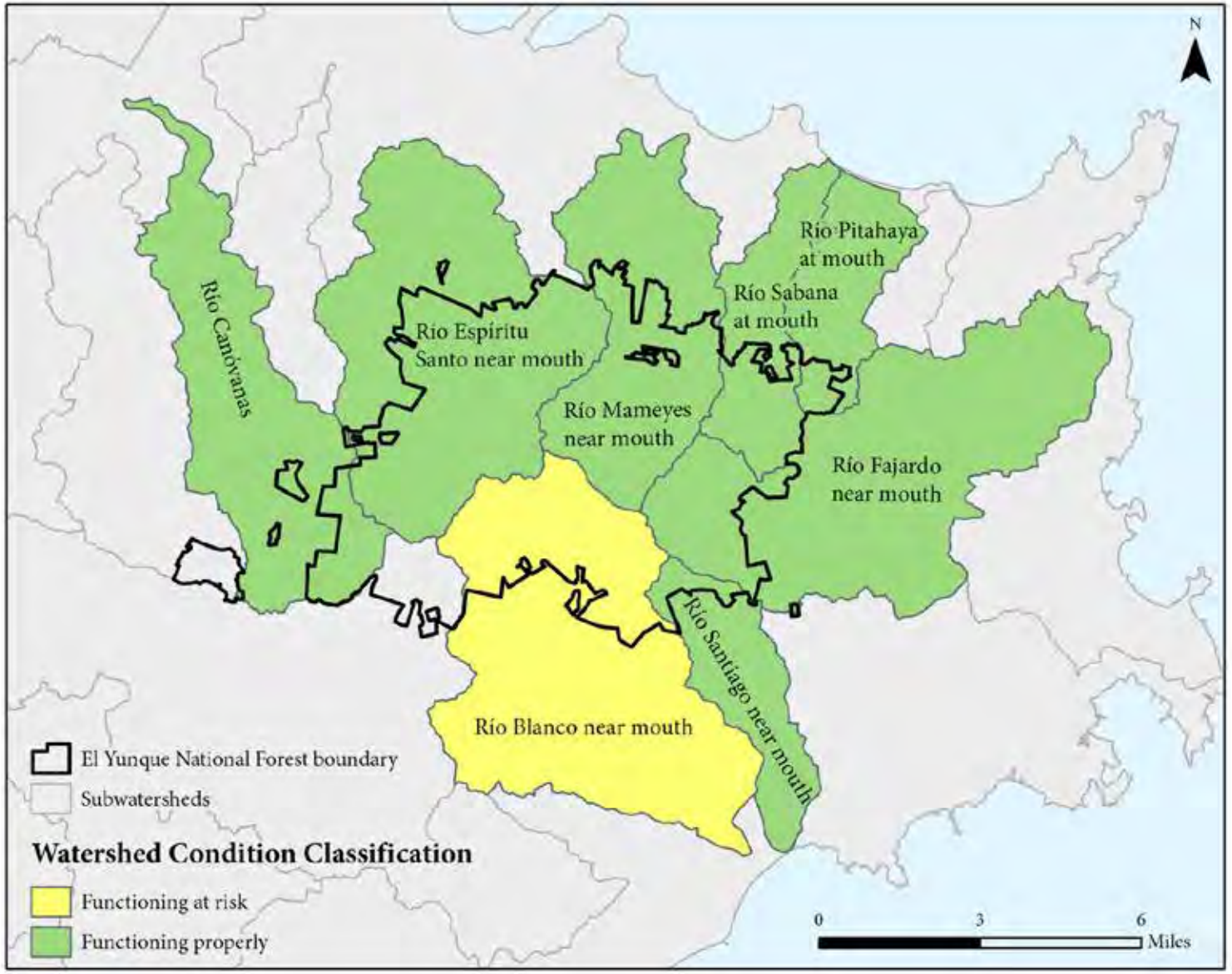
Priority Watersheds

The Rio Blanco watershed was identified as a priority watershed under the watershed condition framework ranking system. The 2014 Forest Plan Assessment provides additional information of the watershed condition and the Plan identifies management strategies considered to improve the watershed health conditions. The watershed was classified as "functioning at risk" as part of the Regional assessment with the watershed condition (map 3-7). The Rio Blanco watershed covers 17,341 acres, 30 percent of which (5,181 acres) are under Forest Service ownership. El Yunque Watershed Condition Classification Supplemental Guidance (2010) results for the Rio Blanco Watershed are presented in table 3-8.

No direct or indirect effects are expected from the implementation of the Plan. The consideration of projects in the management areas has the potential for effects and these effects are summarized in table 3-9. Table 3-10 describes the composite watershed scores that were developed as part of the alternative analysis process using the ecological sustainability evaluation (ESE) tool. Scores were calculated for 10 and 50 years in the future. The score is a relative sustainability ranking from 0 to 10. Scores from 0 to 2.5 means poor or less sustainable, 2.6 to 5.0 means fairly sustainable, 5.1 to 7.5 means good sustainability, and 7.6 to 10 means very good sustainability. For more detailed information about the ecological sustainability evaluation please see appendix B and refere to the planning record.

Table 3-8. El Yunque watershed condition classification supplemental guidance classification for the Rio Blanco Watershed

Water Quantity Condition Indicator	Diversions Not Meeting Standards Developed by FERC Penstock System that Feed the Hydro Power Plant
Water Quantity Condition Indicator	Diversions not meeting standards developed by FERC penstock system that feed the hydro power plant
Aquatic Habitat Condition Indicator	On the Forest functioning at risk: aquatic habitat is not significant impacted but fragmented by FERC dams
Channel Shape and Function	Impaired functioning: Highly erodible soils, high sand content; upper watershed flat and funnels water into channels and causes erosion; landslides have impacted channel shape
Aquatic Biota Condition Indicator	On the Forest functioning at risk: penstock complex has impacted life forms during droughts
Road Maintenance	Impaired functioning: lots of trails and roads which need deferred maintenance
Proximity to Water	Impaired functioning: the extensive trail systems are notable along the streams, because of the nature of the trail system



Map 3-7. Watershed condition classification

Table 3-9. Summary of effects by alternative and watershed

Alternative Name	Indirect Effects	Direct Effects	Cumulative Effects
Rio Canovanas: At Mouth; El Yunque			
No Action	1. Increase of recreation activities considered in the developed recreational area could produce indirect impacts over the riparian vegetation and sensible areas. 2. Access to extract timber as part of the timber demonstration area can produce impacts in the aquatic habitats and can affect the riparian zones.	Direct effects could be expected from the development of recreation facilities considered in the zone and from the timber demonstration.	Because of the recreational activities considered in the no-action alternative, some negative cumulative effects could be expected in the Canovanas River because of visitor pressure and recreational activities concentrated in the watershed.
Alternative 2	The CIRMA includes the possibility of applied community-based enterprises, groups, and other organizations that could cause indirect effects in rivers, floodplains, and riparian zones.	The watershed includes areas considered under the CIRMA Management Area that could be used to disperse the visitors pressure considered in the corridor of PR Road 191. The increase in visitors could impact riparian zones and produce some direct effects in the vegetation.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Canovanas from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Canovanas.
Alternative 3	The CIRMA management area include the possibility of applied community-based enterprises, groups, and other organizations that could cause indirect effects in rivers, floodplains, and riparian zones.	The watershed includes areas considered under the CIRMA Management Area that could be used to disperse the visitor pressure considered in the corridor of PR Road 191. The increase in visitors could impact riparian zones and produce some direct effects in the vegetation.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Canovanas from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Canovanas.

Alternative Name	Indirect Effects	Direct Effects	Cumulative Effects
Rio Espiritu Santo: At Mouth; El Yunque			
No Action	Areas of the watershed are considered under the timber demonstration activity and the activities could produce indirect effects in the drainage areas of the watershed associated with Rio Espiritu Santo.	The watershed includes zones associated with develop recreational areas and integrated management areas. Direct impact could be expected from recreational activities.	The management areas considered under the no-action alternative could produce cumulative impacts associated with visitors and recreational develop areas.
Alternative 2	The expected increase in use and visits in the areas within the watershed could produce additional pressure and trash problems identified in some drainage areas through the watershed landscape.	The watershed includes areas considered under the CIRMA Management Area that could be used to disperse the visitors pressure considered in the corridor of PR Road 191. The increase in visitors could impact riparian zones and produce some direct effects in the vegetation.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Espiritu Santo from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Espiritu Santo.
Alternative 3	The expected increase in use and visits in the areas within the watershed could produce additional pressure and trash problems identified in some drainage areas through the watershed landscape.	The watershed includes areas considered under the CIRMA Management Area that could be used to disperse the visitors pressure considered in the corridor of PR Road 191. The increase in visitors could impact riparian zones and produce some direct effects in the vegetation.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Espiritu Santo from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Espiritu Santo.

Alternative Name	Indirect Effects	Direct Effects	Cumulative Effects
Rio Mameyes: At Mouth; El Yunque			
No Action	The consideration of activities to improve the recreational facilities could cause additional pressure to riparian zones.	The water quality will show the effects of the concentration of visitors in the recreational facilities within the watershed.	Because of the recreational activities considered in the no-action alternative, some negative cumulative effects could be expected in the Mameyes River because of visitor pressure and recreational activities concentrated in the watershed.
Alternative 2	Positive effects should be expected at the watershed level because of the geographic management perspective considered in the alternative.	The lower elevation zones of the watershed are included in the CIRMA management area and the potential activities considered for this area could produce impact in the riparian zones of the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Mameyes from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Mameyes.
Alternative 3	Positive effects should be expected at the watershed level because of the geographic management perspective considered in the alternative.	The lower elevation zones of the watershed are included in the CIRMA management area and the potential activities considered for this area could produce impact in the riparian zones of the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Mameyes from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Mameyes.

Alternative Name	Indirect Effects	Direct Effects	Cumulative Effects
Rio Sabana: At Mouth; El Yunque			
No Action	1. Increase of recreation activities considered in the integrated management area could produce indirect impacts over the riparian vegetation and sensible areas. 2. Access to extract timber as part of the timber demonstration area can produce impacts in the aquatic habitats and can affect the riparian zones.	1. Access to extract timber and the logging activities will produce impacts in the aquatic habitats and can affect the riparian zones.	1. The recreation activities will also produce cumulative effects. 2. There is a risk of affect to the condition of the river because of the combination of activities that can be applied in closer areas of the Forest (timber demonstration, integrated management).
Alternative 2	The CIRMA management area include the possibility of applied community-based enterprises, groups, and other organizations that could produce indirect effects in rivers, floodplains, and riparian zones.	1. The lower elevation zones of the watershed are included in the CIRMA management area and the potential activities considered for this area could produce impact in the riparian zones of the watershed. The higher elevation zones of the watershed are in the natural research area and no impacts from the allowed activities are expected.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Sabana from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Sabana.
Alternative 3	The CIRMA management area include the possibility of applied community-based enterprises, groups, and other organizations that could produce indirect effects in rivers, floodplains, and riparian zones.	The lower elevation zones of the watershed are included in the CIRMA management area and the potential activities considered for this area could produce impact in the riparian zones of the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Sabana from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Sabana.

Alternative Name	Indirect Effects	Direct Effects	Cumulative Effects
Rio Fajardo: At Mouth; El Yunque			
No Action	The areas of the watershed are considered under the integrated management description, and dispersed recreation could produce direct impacts in the Wet Forest of the zone. No indirect effects are expected form the activities applicable in the research natural area.	1. The areas of the watershed are considered under the integrated management description and dispersed recreation could produce direct impacts in the Wet Forest of the zone. 2. The research natural area is also considered under the no-action alternative and no direct effects are expected.	The areas of the watershed have steep terrain and cumulative effects could be expected from landslides that could occur naturally or can be caused by disperse recreation activities.
Alternative 2	The areas of the watershed are considered under the CIRMA Management area and recreation activities could be considered producing indirect impacts in the Wet Forest of the zone. No indirect effects are expected form the activities applicable in the research natural area.	1. Most of the terrain in the watershed is under the Natural Research Baño de Oro Area and no direct effects are expected form the activities. 2. Management application in the CIRMA areas will provide habitat improvement of riparian zones through the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Fajardo from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Fajardo.
Alternative 3	The areas of the watershed are considered under the CIRMA Management area and recreation activities could be considered producing indirect impacts in the Wet Forest of the zone. No indirect effects are expected form the activities applicable in the research natural area.	1. Most of the terrain in the watershed is under the Natural Research Baño de Oro Area and no direct effects are expected form the activities. 2. Management application in the CIRMA areas will provide habitat improvement of riparian zones through the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Fajardo from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Fajardo.

Alternative Name	Indirect Effects	Direct Effects	Cumulative Effects
Rio Santiago: At Mouth; El Yunque			
No Action	The areas of the watershed are considered under the integrated management description and dispersed recreation could produce direct impacts in the Wet Forest of the zone.	The areas of the watershed are considered under the integrated management description and dispersed recreation could produce direct impacts in the Wet Forest of the zone.	The area of the watershed within the Forest is small and no major cumulative impacts are expected from the activities considered under the no-action alternative.
Alternative 2	The areas of the watershed are considered in the CIRMA Management Area and activities directed toward community-based enterprises are considered. Because of the montane wet forest type the considered activities will be directed toward restoration and conservation of the riparian zones reducing the direct and indirect effects.	The areas of the watershed are considered in the CIRMA Management Area and activities directed toward community-based enterprises are considered. Because of the montane wet forest type the considered activities will be directed toward restoration and conservation of the riparian zones reducing the direct and indirect effects	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Santiago from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Santiago.
Alternative 3	The areas of the watershed are considered in the CIRMA Management Area and activities directed toward community-based enterprises are considered. Because of the montane wet forest type the considered activities will be directed toward restoration and conservation of the riparian zones reducing the direct and indirect effects.	The areas of the watershed are considered in the CIRMA Management Area and activities directed toward community-based enterprises are considered. Because of the montane wet forest type the considered activities will be directed toward restoration and conservation of the riparian zones reducing the direct and indirect effects.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Santiago from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Santiago.

Alternative Name	Indirect Effects	Direct Effects	Cumulative Effects
Rio Blanco: At Mouth; El Yunque			
No Action	Increase of recreation activities could produce indirect impacts over the riparian vegetation and sensible areas.	Impacts from the consideration of recreational projects in the watershed.	The expected effects are related to the recreational activities considered in the watershed.
Alternative 2	Soil movements and sediments can be produced from CIRMA projects.	Management application in the CIRMA areas will provide habitat improvement of riparian zones through the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Blanco from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Blanco.
Alternative 3	Soil movements and sediments can be produced from CIRMA projects.	Management application in the CIRMA areas will provide habitat improvement of riparian zones through the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Blanco from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Blanco.

Alternative Name	Indirect Effects	Direct Effects	Cumulative Effects
Rio Pitahaya: At Mouth; El Yunque			
No Action	Increase of recreation activities could produce indirect impacts over the riparian vegetation and sensible areas.	Access to extract timber and the logging activities will produce impacts in the aquatic habitats and can affect the riparian zones.	1. The recreation activities will also produce cumulative effects. 2. There is a risk of affect the condition of the river because of the combination of activities that can be applied in closer areas of the Forest (timber demonstration, integrated management, research, administrative site)
Alternative 2	Soil movements and sediments can be produced from CIRMA projects.	Management application in the CIRMA areas will provide habitat improvement of riparian zones through the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Pitahaya from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Pitahaya.
Alternative 3	1. Soil movements and sediments can be produced from CIRMA projects.	1. Management application in the CIRMA areas will provide habitat improvement of riparian zones through the watershed.	The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population, and the stress this creates on the natural resources. Cumulatively, environmental consequences to the Rio Pitahaya from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall the cumulative effects of all management actions over time are not expected to adversely affect the Rio Pitahaya.

Table 3-10. Element composite scores by alternative as for El Yunque Planning Area calculated by the ecological sustainability evaluation tool

Watershed Name	Planning Area Watershed Score	Watershed Planning Area Sustainability Rating	Alternative Name	Years in the Future	Estimated Watershed Score
Rio Pitahaya at mouth	7.5	Very Good	No Action	10	6.25
	7.5	Very Good	No Action	50	6.25
	7.5	Very Good	Alternative 2	10	6.25
	7.5	Very Good	Alternative 2	50	6.25
	7.5	Very Good	Alternative 3	10	6.25
	7.5	Very Good	Alternative 3	50	6.25
Rio Mameyes at mouth	6.25	Good	No Action	10	4.84
	6.25	Good	No Action	50	4.84
	6.25	Good	Alternative 2	10	4.84
	6.25	Good	Alternative 2	50	6.25
	6.25	Good	Alternative 3	10	4.84
	6.25	Good	Alternative 3	50	6.25
Rio Espiritu Santo near mouth	6.25	Good	No Action	10	6.25
	6.25	Good	No Action	50	5.00
	6.25	Good	Alternative 2	10	6.25
	6.25	Good	Alternative 2	50	5.00
	6.25	Good	Alternative 3	10	6.25
	6.25	Good	Alternative 3	50	7.50
Rio Canovanas	7.5	Very Good	No Action	10	7.50
	7.5	Very Good	No Action	50	5.31
	7.5	Very Good	Alternative 2	10	7.50
	7.5	Very Good	Alternative 2	50	7.50
	7.5	Very Good	Alternative 3	10	7.50
	7.5	Very Good	Alternative 3	50	7.50

Watershed Name	Planning Area Watershed Score	Watershed Planning Area Sustainability Rating	Alternative Name	Years in the Future	Estimated Watershed Score
Rio Santiago near mouth	7.5	Very Good	No Action	10	6.25
	7.5	Very Good	No Action	50	6.25
	7.5	Very Good	Alternative 2	10	6.25
	7.5	Very Good	Alternative 2	50	6.25
	7.5	Very Good	Alternative 3	10	6.25
	7.5	Very Good	Alternative 3	50	6.25
Rio Sabana at mouth	7.5	Very Good	No Action	10	7.50
	7.5	Very Good	No Action	50	7.50
	7.5	Very Good	Alternative 2	10	7.50
	7.5	Very Good	Alternative 2	50	7.50
	7.5	Very Good	Alternative 3	10	7.50
	7.5	Very Good	Alternative 3	50	7.50
Rio Blanco near mouth	6.25	Good	No Action	10	4.84
	6.25	Good	No Action	50	5.31
	6.25	Good	Alternative 2	10	4.84
	6.25	Good	Alternative 2	50	5.31
	6.25	Good	Alternative 3	10	4.84
	6.25	Good	Alternative 3	50	5.31
Rio Fajardo near mouth	7.5	Very Good	No Action	10	7.50
	7.5	Very Good	No Action	50	6.25
	7.5	Very Good	Alternative 2	10	7.50
	7.5	Very Good	Alternative 2	50	6.25
	7.5	Very Good	Alternative 3	10	7.50
	7.5	Very Good	Alternative 3	50	6.25

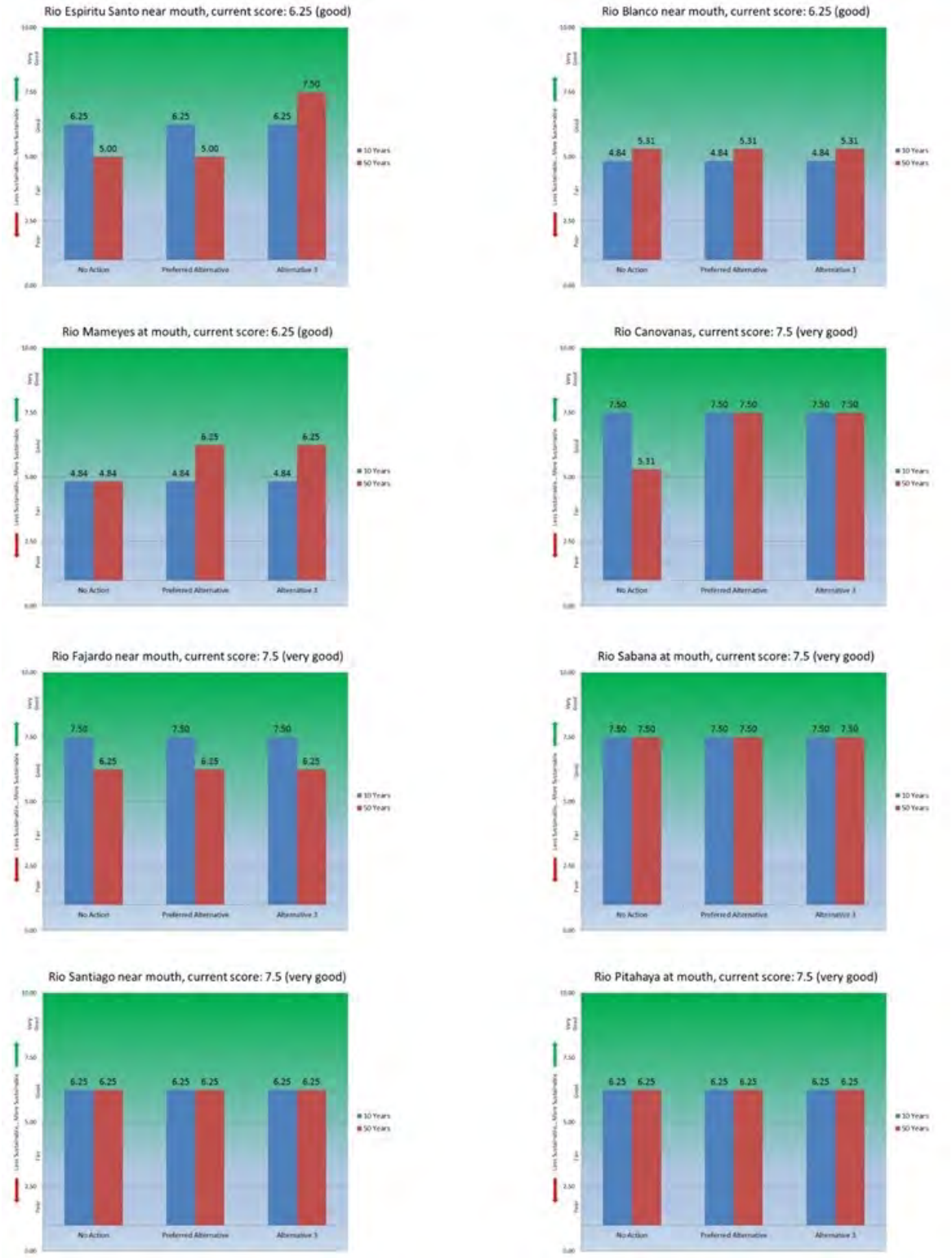


Figure 3-3. Graphic representation by watershed of the ecological sustainability evaluation for El Yunque National Forest Watersheds

3.4 Biological Environment

3.4.1 Ecological Systems

3.4.1.1 Affected Environment

A vegetation classification process was developed for the revision of El Yunque Management Plan in 2013. The geospatial dataset was created and modified at the International Institute of Tropical Forestry (IITF) GIS and Remote Sensing Lab with expertise from scientists and foresters from the IITF and El Yunque. The geospatial data was based on the PRGAP 2000 land cover map (Gould et al. 2007). The original data was modified to better-fit forest management needs. We modified the PRGAP land cover by incorporating information from the Holdridge ecological life zones (Ewel and Whitmore 1973), 600-meter elevation line (USGS), and 3,300-millimeter precipitation line (Daly et al. 2003) to create the new vegetation classification. We also created a 100-foot buffer around the rivers (National Hydrography Dataset) inside the Forest to identify riparian forest. The river buffer zones were separated into submontane moist, montane wet and rain, and montane cloud wet and rain riparian forests using a combination of ecological life zones data and the 600-meter elevation line (USDA Forest Service, El Yunque Forest Plan Assessment 2014)

Vegetation classification provides a common language for the effective management and conservation at all scales. The vegetation can be described by its repeating patterns in species composition and/or growth forms and structure and relationships to the environment in which found. As with any taxonomy, we use vegetation classification to simplify the patterns in order to communicate and share information.

We initiated our mapping efforts using IITF Land Cover 2000–National Vegetation (map 3-8). As analyzed, the Forest contains 15 forest types. This map follows a hierarchy of the National Vegetation Classification (NVC) down to "groups."

1. In the USNVC System D represent division; M represents mega-groups and G represents groups.

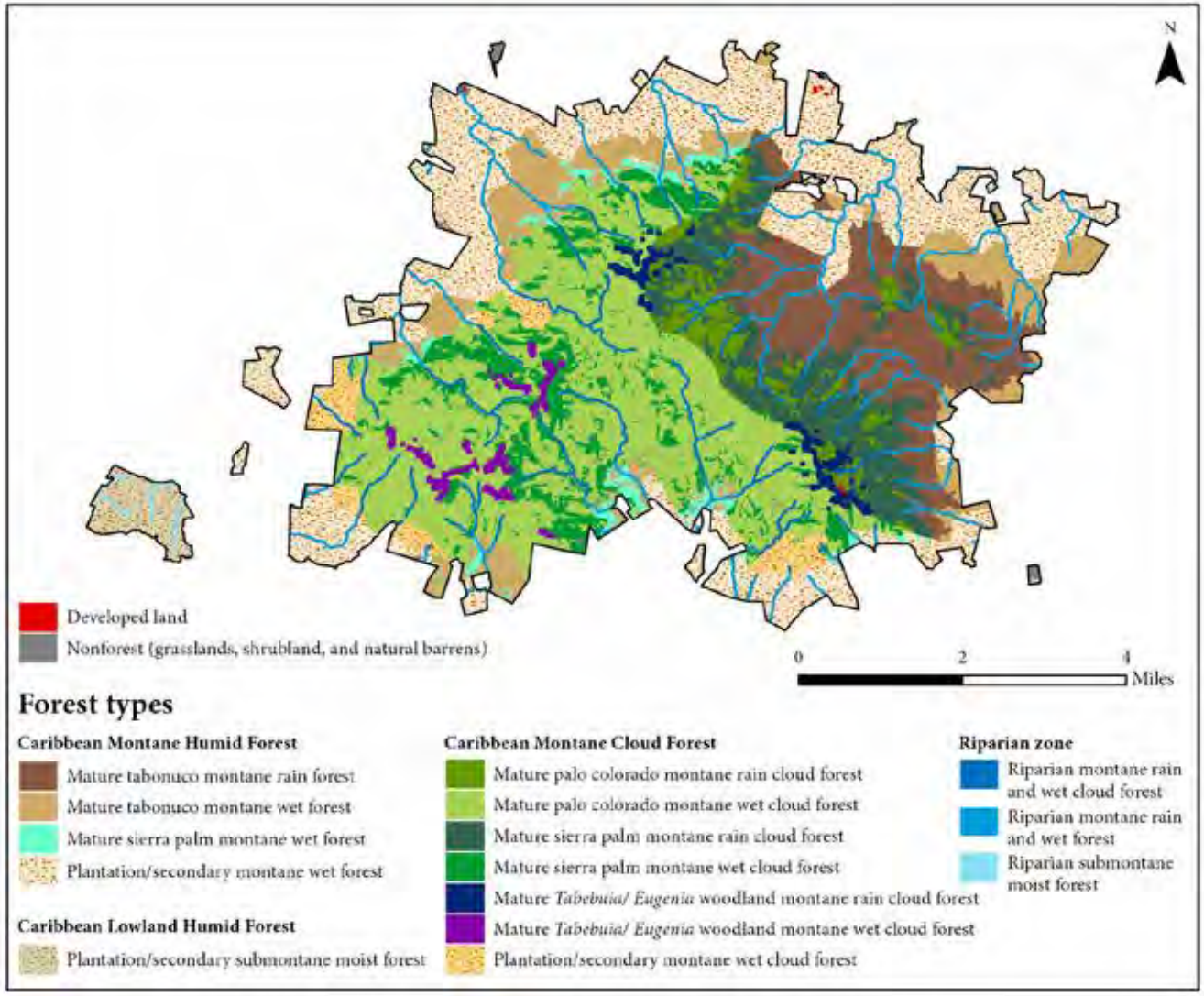
2. The numbers associated with the hierarchal units come from the NVC System nomenclature.

The hierarchy of the NVC continues down with "associations" and "alliances," which focus and refine the ecosystems vegetation or environmental conditions at the scale needed to assess timber stands. See, USDA Forest Service, El Yunque Forest Plan Assessment 2014 for a detailed description of forest types.

Distribution, Extent and Trends of the Luquillo Mountain Range

The Forest is located in the rugged Sierra de Luquillo Mountains, 25 miles southeast of San Juan, Puerto Rico. It is the only tropical forest administered by the USDA Forest Service. Puerto Rico lies between the Atlantic Ocean and the Caribbean Sea; it is the easternmost island of the Greater Antilles. The total land area is 3,421 square miles.

The Forest contains about 29,000 acres. Elevation ranges from 100 to 3,533 feet above sea level. The climate is tropical. Average annual rainfall over the Forest is 120 inches per year. Topography is rugged, with 24 percent of the Forest exhibiting 60 percent slope or steeper. The Luquillo Mountains have a humid maritime climate.


N
Developed land
Nonforest (grasslands, shrubland, and natural barrens)
0
2
4
Miles
Forest types
Caribbean Montane Humid Forest
Mature tabonuco montane rain forest
Mature tabonuco montane wet forest
Mature sierra palm montane wet forest
Plantation/secondary montane wet forest
Caribbean Lowland Humid Forest
Plantation/secondary submontane moist forest
Caribbean Montane Cloud Forest
Mature palo colorado montane rain cloud forest
Mature palo colorado montane wet cloud forest
Mature sierra palm montane rain cloud forest
Mature sierra palm montane wet cloud forest
Mature Tabebuia/ Eugenia woodland montane rain cloud forest
Mature Tabebuia/ Eugenia woodland montane wet cloud forest
Plantation/secondary montane wet cloud forest
Riparian zone
Riparian montane rain and wet cloud forest
Riparian montane rain and wet forest
Riparian submontane moist forest

Map 3-8. El Yunque National Forest vegetation map

Source: Quiñones, M.; Rivera, L.A.; Gould, W.A. 2013. El Yunque National Forest vegetation map. Terrestrial Ecosystem Assessment chapter of the land and resources management plan revision for El Yunque National Forest. Vector data. USDA Forest Service, San Juan, Puerto Rico.

Table 3-11. Vegetation classification, El Yunque National Forest

El Yunque Vegetation Classification	Area (acres)
M279 Caribbean Montane Humid Forest	
G448 Caribbean Wet Montane Forest Group	
Mature Tabonuco Montane Rain Forest	3,471
Mature Tabonuco Montane Wet Forest	2,619
Mature Sierra Palm Montane Wet Forest	496
Secondary Montane Wet Forest	5,843
M280 Caribbean Cloud Forest	
G451 Caribbean Montane Cloud Forest Group	
Mature Palo Colorado Montane Rain Cloud Forest	918
Mature Palo Colorado Montane Wet Cloud Forest	6,808
Mature Sierra Palm Montane Rain Cloud Forest	2,142
Mature Sierra Palm Montane Wet Cloud Forest	2,035
Mature *Tabebuia/Eugenia* Woodland Montane Rain Cloud Forest	342
Mature *Tabebuia/Eugenia* Woodland Montane Wet Cloud Forest	298
Secondary Montane Wet Cloud Forest	725
M281 Caribbean Lowland Humid Forest	
G454 Caribbean Moist Lowland Submontane Forest	
Secondary Submontane Moist Forest	506
Riparian Forest	
Riparian Montane Rain and Wet Cloud Forest	705
Riparian Montane Rain and Wet Forest	1,350
Riparian Submontane Moist Forest	59
Non Forest	
Non Forest -Natural Barrens, Grasslands and Shrublands	297
Developed	19
Grand Total	28,633

Although El Yunque is one of the smallest forests in the National Forest System (29,000 acres or roughly 11,300 hectares), it is one of the most biologically diverse areas that the Forest Service manages. El Yunque contains at least 830 native species of plants (Weaver et al. 2013) and over 240 species of native trees, of which 88 are rare or endemic. Sixty-eight (68) are limited to Puerto Rico and 23 are only found in the Forest. Along with the trees, El Yunque includes 50 species of native orchids and over 150 species of ferns. This relatively small land area also supports 127 species of terrestrial vertebrate (land animals with backbones) and 10 species of aquatic invertebrates (water animals without backbones) ([LRMP] USDA Forest Service 1997).

Luquillo Mountain Range Ecosystems

The forest types of El Yunque support a large diversity of tropical species. The dominant life zone distinctions include subtropical wet forest, subtropical rain forests, and subtropical lower montane wet and rain forests. In El Yunque, forest types and community structure shift as a result of continuous change in cloud cover, wind exposure, soil moisture, temperature, and precipitation across an elevational gradient, with land use intensity decreasing with elevation from secondary lowlands forests to protected peaks (Jennings et al. 2014).

El Yunque Forest Types

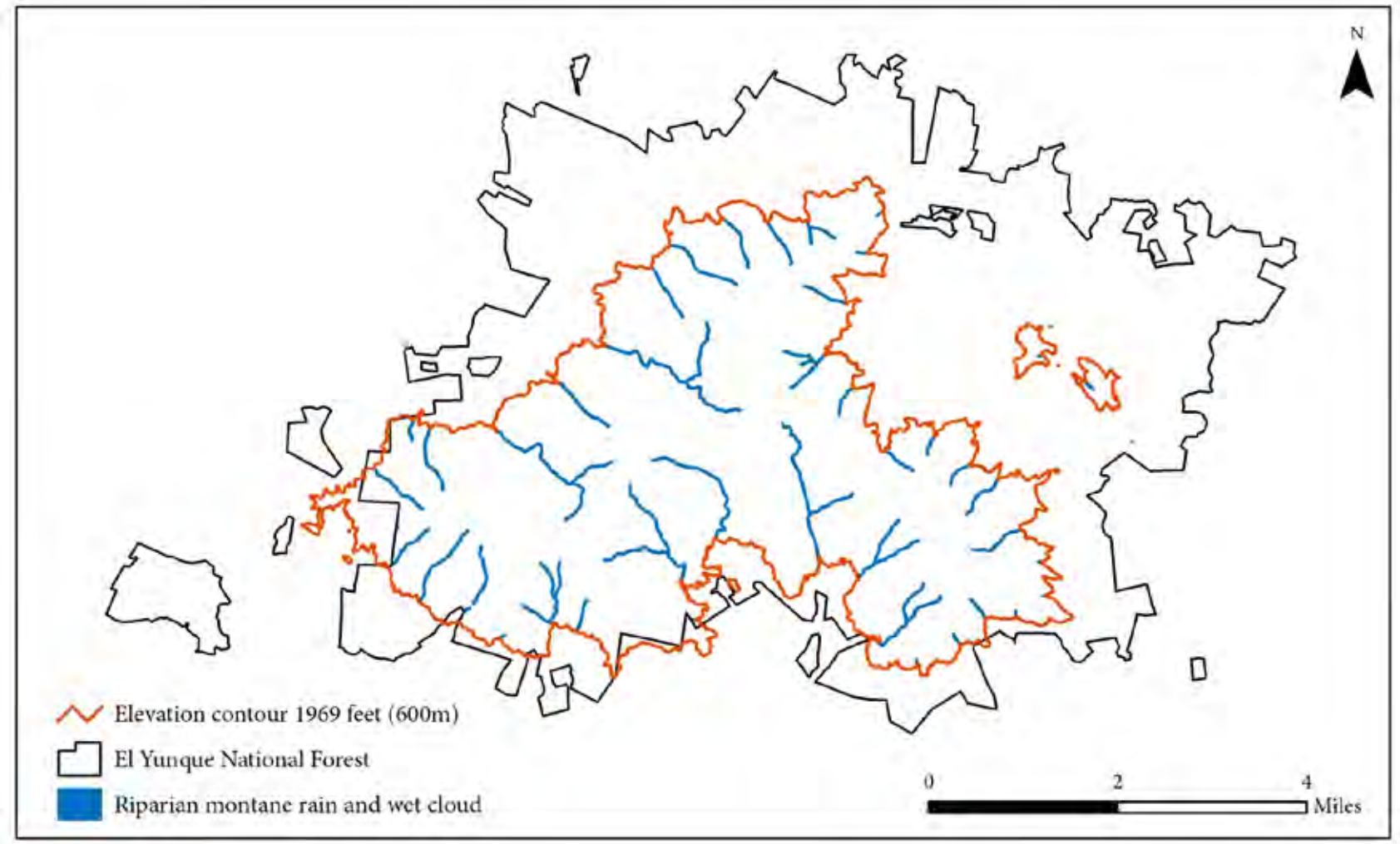
Functional Montane Wetland

All plant communities located above the 600-meter elevation line at El Yunque, above the cloud condensation level, are wetland communities. The three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology (Cowardin et al. 1979; U.S. Army Corps of Engineers 1987; National Research Council 1995; Tiner and Burke 1995). The 600-meter elevation boundary determines where clouds will form and, thus, where the Cloud Forest community begins (Harris et al. 2012). From the total of 1,487 plant species listed on the Puerto Rico 2012 Final Regional Wetland Plant List (prepared by the U.S. Army Corps of Engineers), 559 (or 38 percent) of the list is reported to be present on El Yunque. All of the 559 wetland plant species present at El Yunque are above the 600-meter elevation boundary. These lands represent 46.76 percent of El Yunque or 13,268 acres.

See map 3-9 for the location of forest types inside the wetland (all lands above 600 meters of elevation). The number of acres for each vegetation type is included below.

Table 3-12. Vegetation types and acreage in the functional montane wetland

Community	Acres
Mature Palo Colorado Montane Rain Cloud Forest	918
Mature Palo Colorado Montane Wet Cloud Forest	6,808
Mature Sierra Palm Montane Rain Cloud Forest	2,142
Mature Sierra Palm Montane Wet Cloud Forest	2,035
Mature *Tabebuia/Eugenia* Woodland Montane Rain Cloud Forest	342
Mature *Tabebuia/Eugenia* Woodland Montane Wet Cloud Forest	298
Secondary Montane Wet Cloud Forest	725



Map 3-9. Watershed wetland map

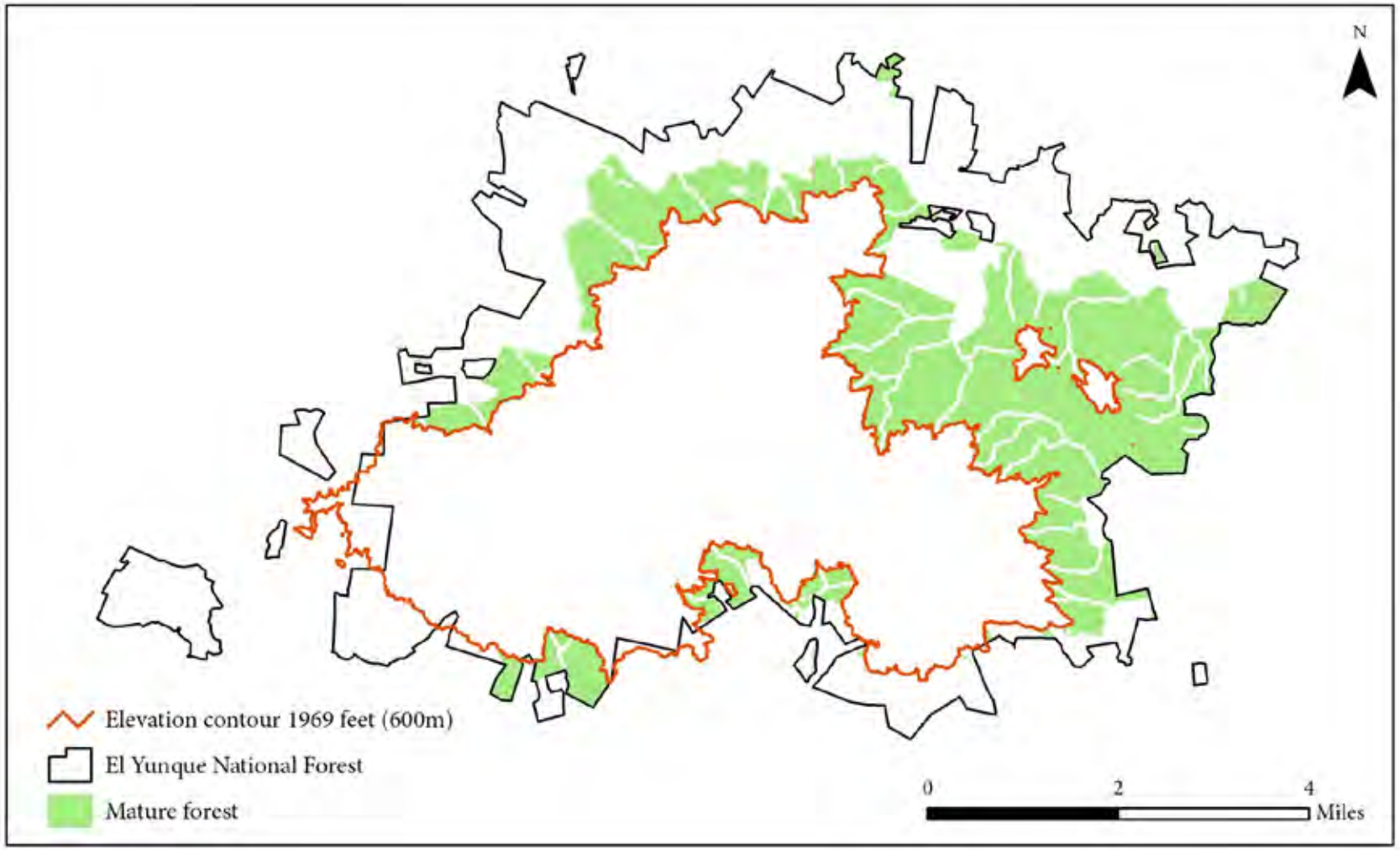
Mature Forest

Mature forest refers to old-growth vegetation that has not been clear cut and that its structure and composition has not been significantly altered by anthropogenic disturbances. The largest block of such lands in Puerto Rico is in El Yunque, an area of approximately 13,700 acres. Most of El Yunque mature forest is protected under a designated area (wilderness, research natural area, wild and scenic river, wetland and riparian zones) and the majority of it is over the 600-meters elevation line. There is other mature forest outside this area (as shown in map 3-10) that are part of the mature Tabonuco montane rain forest (3,470.54 acres) and the mature Tabonuco montane wet forest (2,619.04 acres).

See map 3-10 for the location of vegetation types inside the mature forest below the 600-meter elevation line. The number of acres for each vegetation type is included below.

Table 3-13. Vegetation types of the mature forest below 600 meters of elevation

Vegetation Type	Acres
Mature Tabonuco Montane Rain Forest	3470.54
Mature Tabonuco Montane Wet Forest	2619.04



Map 3-10. Mature forest types below 600 meters

Montane Wet Secondary Forest

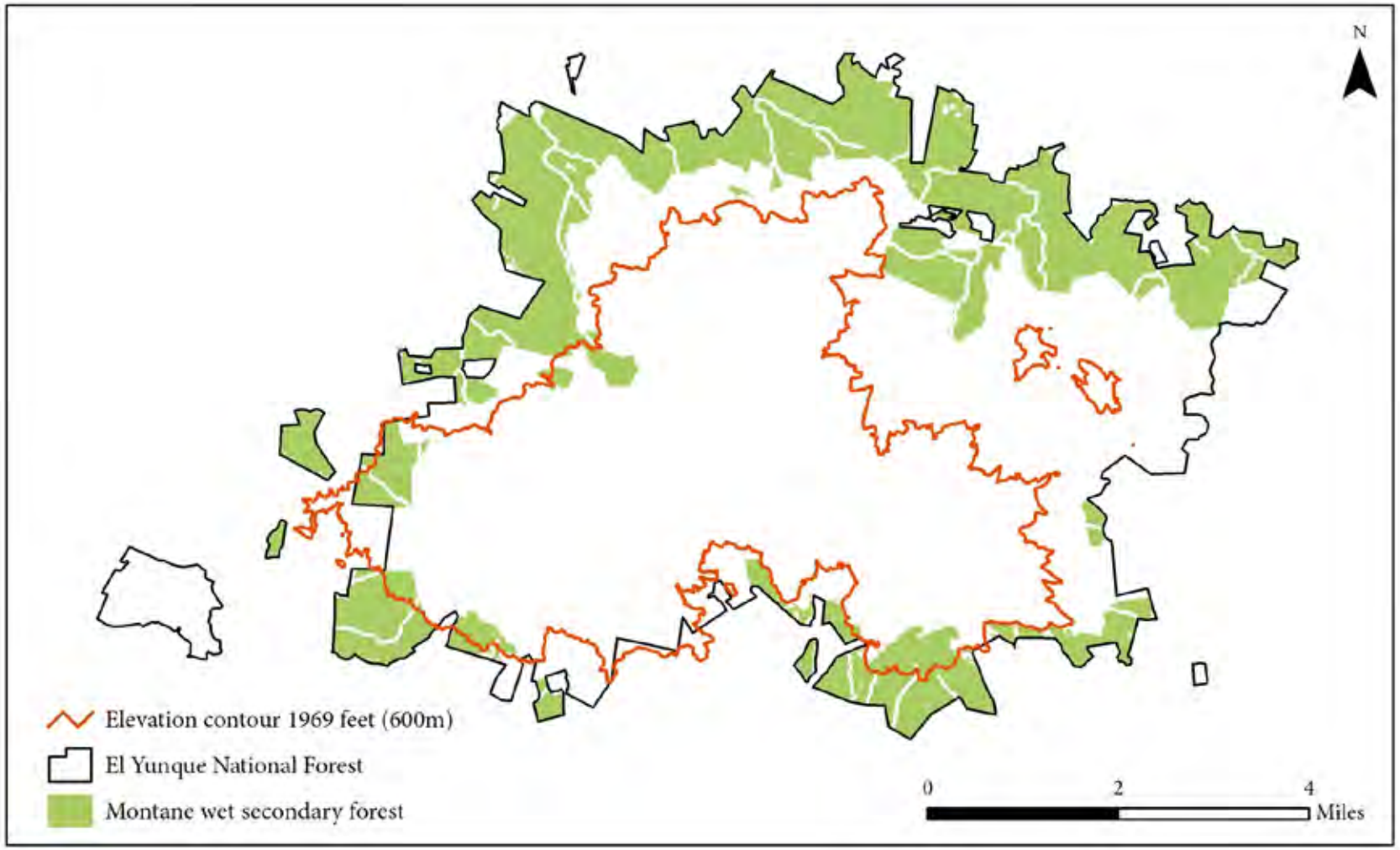
Researchers examined secondary forest stands growing on abandoned pastures on the lower northern slopes of the Luquillo Mountains. After 40 years of recovery, these stands could not be distinguished from undisturbed sites in terms of density, basal area, species numbers, or diversity. Secondary forests recovering after anthropogenic disturbance on the lower slopes of the Luquillo Mountains will most probably carry the signature of past land use for several centuries, at least with regard to species composition. Since the 1920s, at least 120 tree species were introduced into El Yunque, including 112 invasive and 8 species native to other areas in Puerto Rico. Most were planted along El Yunque northeastern, western, and southern borders for timber production and watershed protection (Weaver et al. 2013). Although secondary forest has regenerated throughout the lower areas of El Yunque during the past 70 years, much of boundary area still contains numerous introduced native and invasive trees (Weaver et al. 2013).

Secondary forests are forests regenerating largely through natural processes after significant human and/or natural disturbance of the original forest vegetation at a single point in time or over an extended period, and displaying a major difference in forest structure and/or canopy species composition with respect to nearby mature forests on similar sites (Chokkalingam et al. 2001). Map 3-11 includes the secondary montane wet forest and secondary sub-montane moist forest.

See map 3-11 for the location of vegetation types inside the montane wet secondary forest. The number of acres for each vegetation type is included below.

Table 3-14. Vegetation types of the montane wet secondary forest

Vegetation Type	Acres
Secondary Montane Wet Forest	5,843.41
Secondary Sub-montane Moist Forest	505.85



Map 3-11. Montane wet secondary forest

Riparian Zones

A riparian zone or riparian area is the interface between land and a river or stream. Plant habitats and communities along the river margins and banks are called riparian vegetation, characterized by hydrophilic plants. A riparian forest is the woodlands along the banks of stream or river. On El Yunque the width of this riparian zone is 100 feet from each side of the river or the stream bank.

In El Yunque, forest types inside riparian zones are montane pterocarpus forest, riverine palm and riparian forest (Harris et al. 2012).

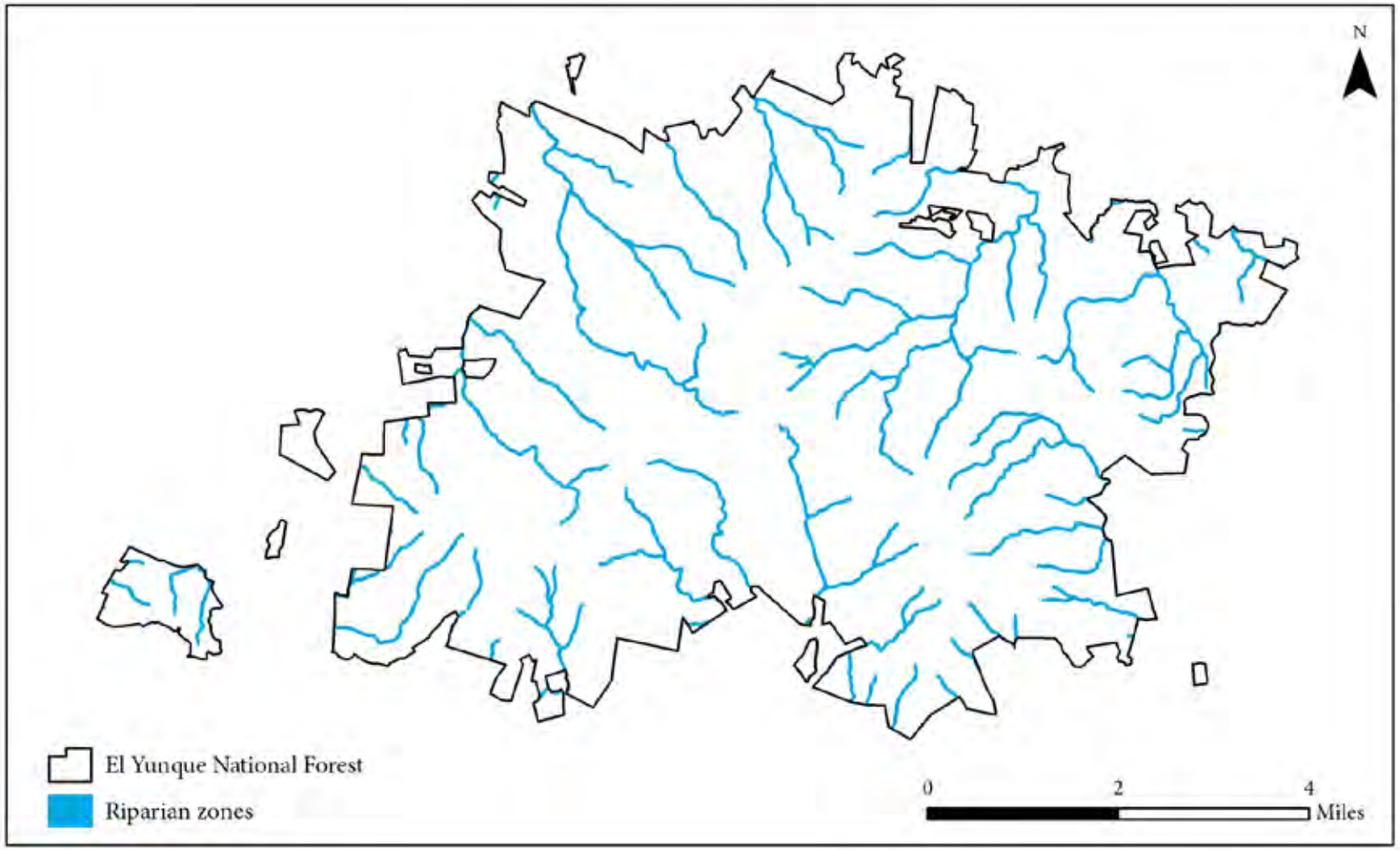
Vegetation transects along a fluvial disturbance gradient from the middle of the channel into the adjacent forest follows a consistent pattern. Cushion mosses colonize in-channel boulders, whereas herbs, ferns, and grasses grow along channel margins. Woody shrubs and trees establish on higher, less frequently flooded surfaces. Vegetation stature similarly increases with the relative elevation above the channel. Short-stature vegetation grows along the channel and tall, closed-canopy woody vegetation and tall grasses grow on the banks and hill slopes (Pike and Scatena 2009).

Mosses and lichens that require shade are more common in steep land streams having ample canopy cover. Wider lowland channels have a greater amount of incidental light and consequently have a greater abundance of grasses. Furthermore, there is no distinct riparian forest community in the headwater streams of the Luquillo Mountains. The continually humid climate of the Luquillo Mountains results in both riparian and non-riparian forests having ample moisture availability and are consequently similar in composition, but can be different in structure and biomass (Pike and Scatena 2009).

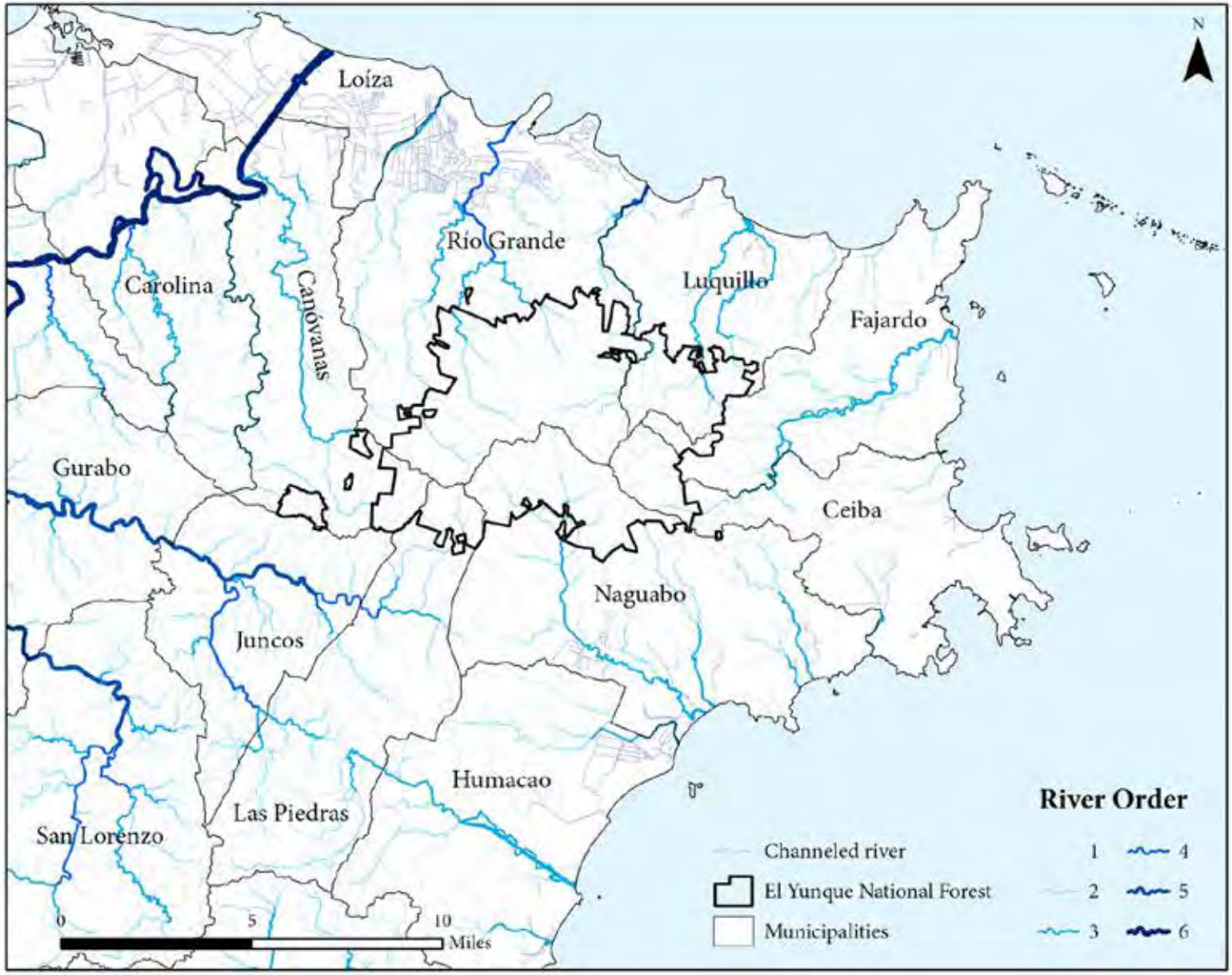
See map 3-12 for the location of vegetation types inside the riparian zones. The number of acres for each riparian area type is included below.

Table 3-15. Vegetation types of the Riparian zones at El Yunque

Community	Acres
Riparian Montane Rain and Wet Cloud Forest	705
Riparian Montane Rain and Wet Forest	1350
Riparian Submontane Moist Forest	59



Map 3-12. Riparian zones



Map 3-13. El Yunque National Forest rivers

Embedded Rare Communities

The Subtropical Montane Rain Forest Zone

The wettest of the sea-level belt of subtropical life zones (lower rainfall limit about 3,800 millimeters), occupies very little area in Puerto Rico, occurring only in a single crescent-shaped band on the windward faces of the Luquillo Mountains (above 600 meter above sea level). It lies wholly within El Yunque and encompasses much of the area traversed by visitors going to the recreation area in "the rain forest" (La Mina Recreational Area). This life zone is characterized by a super abundance of precipitation. The water regime at La Mina indicates that the soil is at field capacity all year, and abundant runoff is produced every month, with 6 months each year yielding more than 300 millimeters. The annual total of 3,400 millimeters of runoff is more than twice as much as most areas of the world receive as annual rainfall input. The constantly wet soil eliminates water as a potentially limiting growth factor in this environment, but oxygen stress, which can inhibit root respiration, may exert an important influence on plant growth (Ewel and Whitmore 1973).

The species found here are essentially the same as those found in the surrounding subtropical montane wet cloud forest. The main features of the subtropical montane rain cloud forest are the high frequency of palms, *Prestoea montana* (sierra palm), and a super abundance of epiphytes. The spiny tree fern, *Nephelea portoricensis*, is more abundant here than in the subtropical montane wet cloud forest (Ewel and Whitmore 1973). Because of the small area it occupies, the subtropical rain forest in Puerto Rico is primarily of academic interest and recreational value. The Baño de Oro Research Natural Area, much of which lies in this life zone, may be the only place in the world where an example of the mature vegetation of subtropical montane rain forest is likely to receive long-term protection, while still being readily accessible (Ewel and Whitmore 1973).

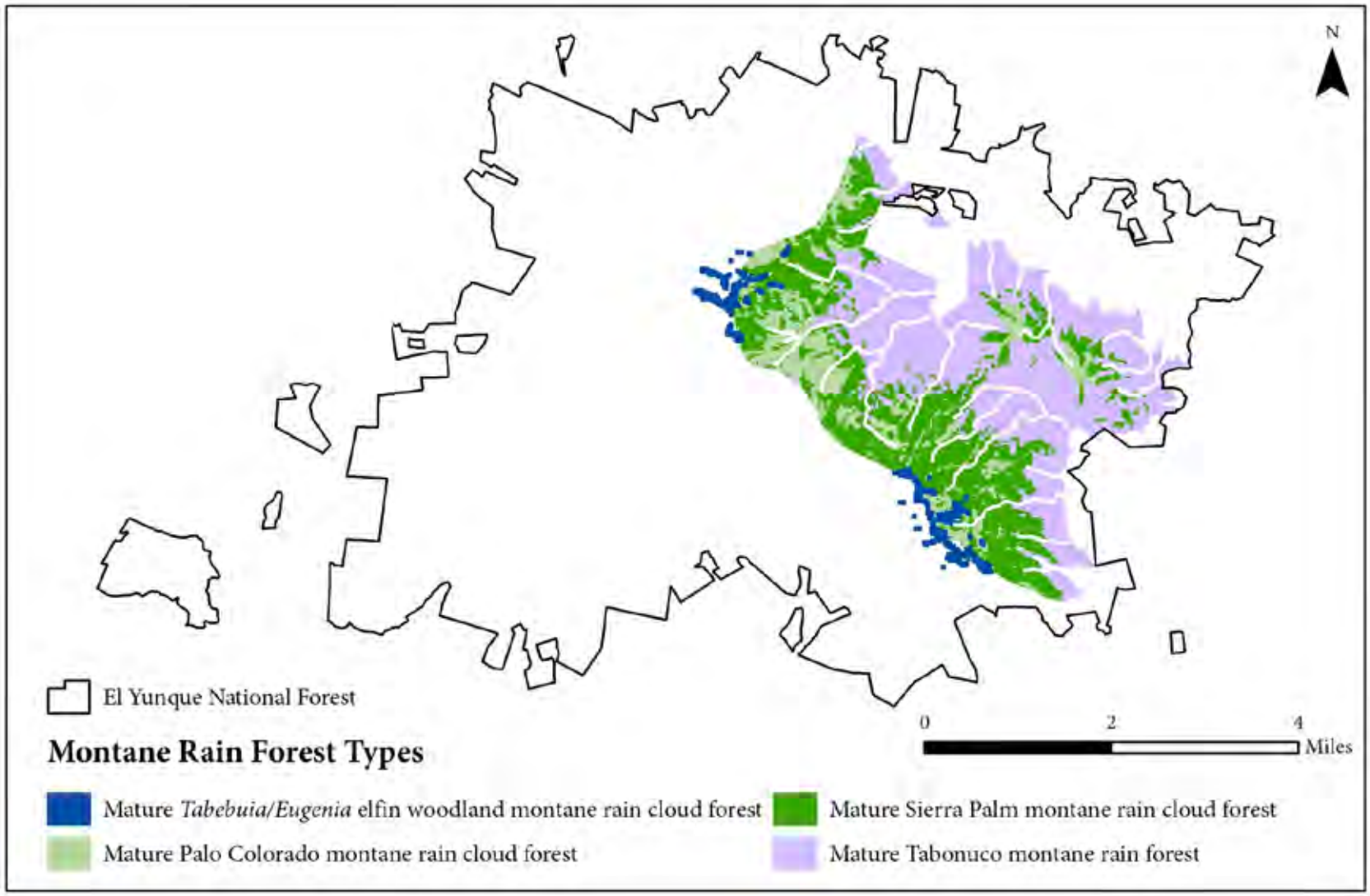
The Subtropical Lower Montane Rain Forest Zone (Mature Tabonuco Montane Rain Forest)

This life zone occupies less area than any other in Puerto Rico and the U. S. Virgin Islands, and is found only in a narrow band on the windward slopes of the Luquillo Mountains, immediately above the subtropical montane wet forest. Here, there is a mean annual of 18.6 °C, an annual rainfall of 4,533 millimeters, and a mean relative humidity of 98.5 percent. If these conditions can be considered representative of the long-term mean values for this site, they would indicate an average, year-round runoff of almost 300 millimeters per month, and some months could yield almost twice that amount. The vegetation of this life zone in Puerto Rico is very similar to that of lower montane wet forest; the characteristic which distinguishes the two, is the greater abundance of epiphytes, epiphyllae, palms, and tree ferns in the lower montane rain forest. Most of this life zone in Puerto Rico is in the elfin cloud forest association (*Tabebuia/Eugenia* Woodland), where much of the vegetation on the exposed ridges has a windswept appearance. Howard (1969) described the morphology and structure of many of the species found in this environment, while Gilt (1969) documented the formation of aerial roots, which are extremely abundant on many species in this association. The water-saturated soil is covered with a soil-free root mat, and the root-soil-earthworm relationships here were investigated by Lyford (1969). Epiphytes, most of which are leafy hepatics, cover everything; this component of the flora was described by Fulford et al. (1970). Weaver (1972) removed all of the epiphytes from three plots and compared these to plots with the epiphytes left intact. He found that although the total amount of water reaching the ground was slightly affected, the distribution pattern of through fall and stem flow was significantly altered. Since the mature Tabonuco montane rain forest ecosystem is an environemtal extreme and is constrained to a small area in the forest, it is very succeptible to intense hurricanes. It is indeed fortunate that the limited amount of this life zone in Puerto Rico is located in a publicly-controlled forest, including the upper parts of the Baño de Oro Research Natural Area where long-term protection is the goal (Ewel and Whitmore1973).

See map 3-14 for the location of vegetation types inside the montane rain forest vegetation types. The number of acres for each vegetation type is included below.

Table 3-16. Vegetation types inside the montane rain forest

Community	Acres
Mature *Tabebuia/Eugenia* Woodland Montane Rain Cloud Forest	345
Mature Tabonuco Montane Rain Forest	3,471
Mature Palo Colorado Montane Rain Cloud Forest	918
Mature Sierra Palm Montane Rain Cloud Forest	2,142



Map 3-14. Montane rain forest

Process for Evaluating Effects to Ecosystem Integrity and Sustainability

Steps used to build an ecological sustainability framework are documented within the ecological sustainability evaluation (ESE) tool and described in Appendix B. The ESE tool, a relational database, is based on the structure of the ecological planning tool designed by The Nature Conservancy. The ESE database serves as the source for evaluating ecosystem diversity on El Yunque and developing plan components for the new revised Forest Plan.

To evaluate ecological sustainability, the planning team identified key characteristics for each ecosystem, identified measurable indicators for each key characteristic, weighted them in importance and defined ranges of acceptability for each ecosystem across each alternative, both at 10- and 50-year timeframes. This process is further described in appendix B and in the ESE tool.

Indicators and Details

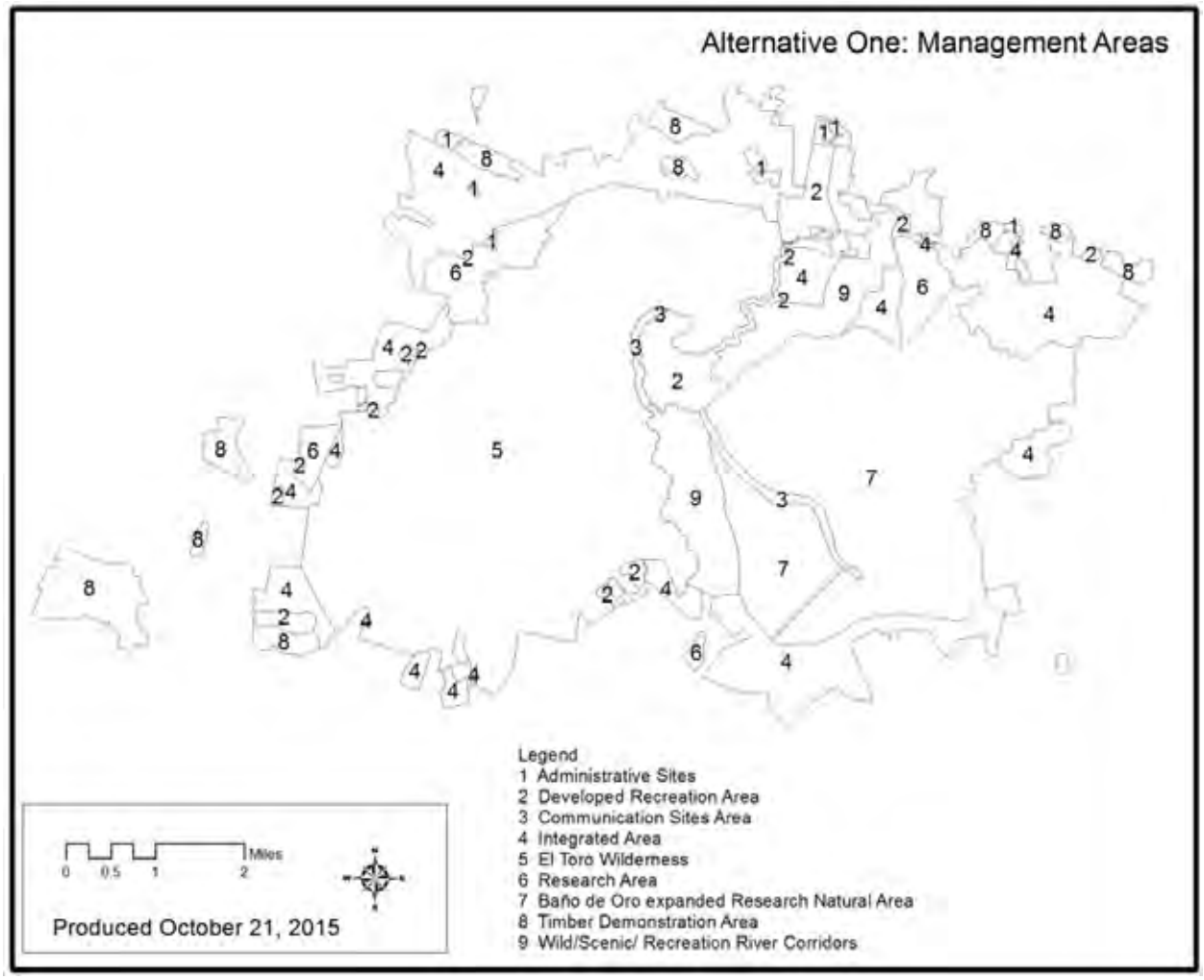
- Changes in spatial extent
- Deviation from natural range of variability
- Paved open road density
- Recreational area density
- Trail density
- Percent of non-desirable invasive species
- Percent of change of the structure and composition of the Forest
- Percent of roads and recreational facilities under construction/repair

The passing of Hurricanes Irma and Maria on September 2017 impacted the structure and composition of the forest and the resulting open canopy could expand the distribution of invasive species. However, with all these changes in the forest, the ecological sustainability evaluation tool analysis results will not change since the impacts have affected all alternatives equally, resulting in the relative differences between the alternatives still being valid.

3.4.1.2 Environmental Consequences

Alternative 1

Alternative 1 will maintain and preserve the management areas and activities per the 1997 Land and Resource Management Plan for El Yunque National Forest. Map 3-15 describes the management areas as delineated in alternative 1.



Map 3-15. Alternative 1 management areas (1997 Land Management Plan)

Source: Forest Service Planning Maps (2015).

Functional Montane Wetlands

Affected Environment

All plant communities located above the 600-meter elevation line on El Yunque, above the cloud condensation level, are wetland communities. Above this line determines where clouds will form and, thus, where the cloud forest community begins. All of these lands have characteristics of wetlands, that is, hydrophytic vegetation, hydric soils, and wetland hydrology.

Effects

Alternative 1 includes parts of management areas; integrated areas, developed recreation, and research area inside the 600 meters above sea level. Activities proposed for these management areas will have impacts if implemented inside the functional wetland. Vegetation, hydric soils, and hydrology are expected to be negatively affected by the implementation of proposed activities inside the wetland. Best management practices (BMP) and mitigation measures will minimize the effects of implementing this alternative.

The maintenance and repair of trails with the 1997 Forest Plan protocols have the potential to affect the wetland conditions, particularly in the surrounding mature forest along the trails.

The recreational areas are within the functional wetland and the montane rain forest zone (a unique ecosystem to Puerto Rico, only present at El Yunque). Maintaining the visitation plan directly impacts the water quality, soils, vegetation, air quality and wildlife. Infrastructure maintenance also affects these other resources, and as result, the vegetation may change in its composition, particularly federally listed species and species of conservation concern known to inhabit along the trail system that traverses the wetland and the rain forest zone (6.1 miles of trail).

Potential effects that could occur from management action that are inside the functional wetland include soil erosion, stream sedimentation, hydrologic system disturbance, disturbance to wildlife and disturbance to ground cover and shrub population in the general area of proposed project sites.

Cumulative Effects:

The cumulative effects analyzed for the functional wetland are based on management practices within the Forest boundary; although under new regulation, using collaboration in forest management and the "all-lands" approach, could assist in mitigating effects such as impact to the riparian zone and estuarine areas (inside and outside Forest boundaries). The time for the analysis of the framework is 15 years or the life of the plan. It will be necessary to analyze how much private land falls within the 600-meter elevation belt; defined as a wetland. Under this alternative the wetland could be impacted cumulatively by uses described in the Forest Plan such as developed recreation, urban development and climate change. For climate change impact see "Forest Service Research and Development, General Technical Report SR-193."

The cumulative effects are associated to the timing and addition of projects allowed in the management areas at the same time. Considering the construction of recreation sites, actions of research activities and projects in the integrated management area has the potential to produce cumulative effects in the functional wetland forest type.

Overall implementation of alternative 1 will modify the functional wetland's vegetation, hydric soils and hydrology.

Mature Forest

Effects

Although Alternative 1 protects the mature forest with a series of plan components such as wilderness, wild and scenic rivers, and natural research area designations, there are some pockets of mature forest allocated to other management areas (research, integrated and develop recreation) that can affect the integrity and character of the mature forest. There would be potential for impacts to the mature forest in areas surrounding the project site. Also the potential of introduction of invasive species to its surroundings may occur.

Cumulative Effects

Allowed projects will have secondary impact to the integrity of the surroundings mature forest along a time scale (15 years or the life of the plan) as other activities close to the project site create impacts that will overlap. The cumulative effects analyzed for the mature forest are based on management practices within the Forest boundary; although under new regulation, using collaboration and the "all-lands" approach could assist in mitigating effects of impacts to the mature forest. The cumulative effects under this alternative would be related to recreation development in the areas of mature forest. Continued recreation use within the mature forest will cumulatively effect vegetation and species in these sensitive areas.

Overall, alternative 1 has potential to affect the mature forest directly by reduction of its size, integrity, and character. The cumulative effects under this alternative are not consistent with the vision established in the new management plan and are not compatible with the core management theme of conserve and restore ecosystems for this forest type.

Montane Wet Secondary Forest

Affected Environment

Secondary forests are forests regenerating largely through natural processes after significant human and/or natural disturbance of the original forest vegetation at a single point in time or over an extended period. They could display major differences in forest structure and/or canopy species composition with respect to nearby mature forests on similar sites.

Effects

Alternative 1 proposes for these lands the management areas of: timber demonstration, developed recreation, administrative sites, research and integrated management area. The area included in these management areas are: develop recreation—1,348 acres; timber demonstration—1,167 acres; integrated—6,219 acres; research—919 acres; and 204 acres in administrative sites for a total of 9,857 acres (which represents around 35 percent of El Yunque lands). About 6,348 acres have being identified as secondary forest, the rest, 3,509 acres, will be on mature forest. Even though there are standards and guidelines to protect the mature forest, part of it is located in management areas where it may be affected by proposed projects.

There would be potential for direct impacts to the following resources: watersheds, riparian zones, aquatic habitats and species, flora and fauna, soil, species of conservation concern, recreation, scenery, ecological services, forest products, and timber. Soil erosion and compaction, stream sedimentation, wildlife disturbance, habitat for flora and fauna disturbance and reduction, diversity, scenic values, vegetation and habitat for species of conservation concern will be part of the effects on these lands with the implementation of the potential projects allowed in these management areas. See other sections for more detail on effects to the resources.

Potential impacts from alternative 1 are related to increased recreation activities; recovery of species and diversity; recovery of forest crown cover; recovery of appropriate habitat for plants and animals; soil recovery and potential encroachment of invasive species.

Cumulative Effects

The implementation of numerous projects in the same watershed increases the risks of impairment to watersheds on the Forest during the life of the plan, as other activities close to the project site create impacts that will overlap. The cumulative effects analyzed for the montane wet secondary forest are based on management practices within the Forest boundary; although under new regulation, using collaboration and the “all-lands” approach could assist in mitigating effects of Forest multiple uses and climate change impacts.

Overall, alternative 1 will have the potential to affect several resources, some of which may take decades to recover.

Riparian zones

Affected Environment

A riparian zone or riparian area is the interface between land and a river or stream. A riparian forest is the woodlands along the banks of stream or river. On El Yunque, the width of this riparian zone is designated as 100 feet from each river or stream bank, until actual field delineations are made. It has been calculated

as 2,113 acres along an altitudinal gradient. The riparian zones network interacts with El Yunque in all cardinal directions from the peaks to its boundaries.

Effects

Under alternative 1, the timber demonstration and developed recreation management areas are the ones with high potential to impact the riparian zones while preparing access to extract timber and the logging activities themselves. The developed recreation sites are all associated with a stream, which is the preferred feature in the location of the sites. Some visitors to the Forest prefer to wade in water and recreate in the riparian zone when facilities are full or want to interact with the Forest outside the developed picnic shelters. Dispersed recreation in the integrated management area could also impact the riparian area if the site is heavily visited. The resources expected to be impacted are water quality, aquatic habitat and species, wildlife, soil, and riparian vegetation. Trash generated by visitor and the proper handling of it is another impact to the environment in high visited sites. See other sections for more details on effects to the resources.

Potential indirect impacts are associated with soil erosion, soil compaction, vegetation trampling, and fine sediment movement in the water channel.

Cumulative Effects

Impacts could eventually overlap when timber management and developed recreation areas are relatively close. The time scale of this analysis is of 15 years or the life of the plan. The cumulative effects analyzed for the riparian zones are based on management practices within the Forest boundary; although under new regulation which uses collaboration and the "all-lands" approach could assist in mitigating effects. This alternative does not consider land acquisition along riverbanks to protect riparian zones which could have cumulative effects.

Overall, alternative 1 will have potential to affect the riparian area resource, if implemented in these lands without an appropriated buffer or some capacity control to the recreational sites.

Alternative 2

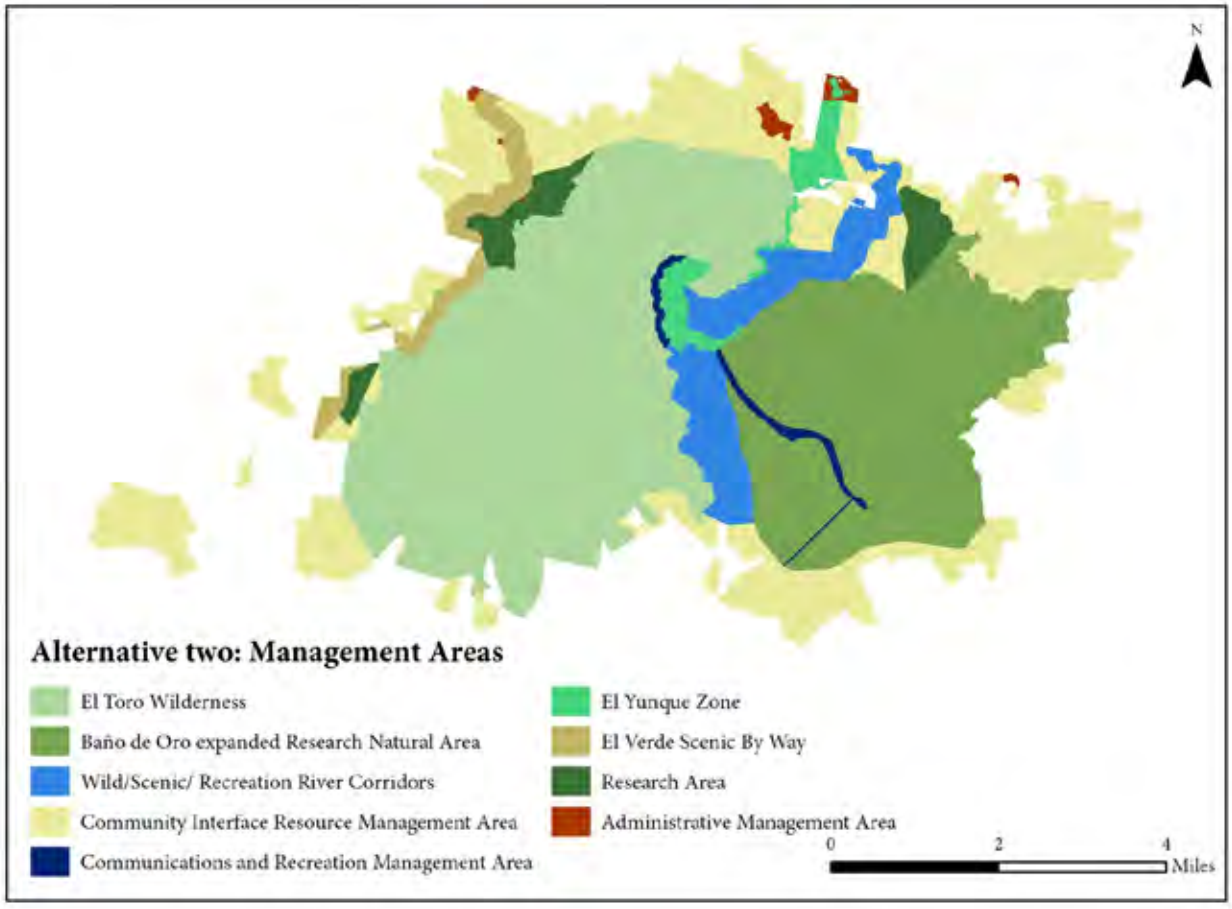
Refer to map 3-16 for alternative 2 management areas.

Functional Montane Wetland

Effects

In alternative 2, most of the lands above the 600-meter altitude line (functional wetland) are assigned to El Toro Wilderness, wild and scenic river corridors and Baño de Oro Research Natural Area; management areas that are protected designated lands.

Management areas for communication, the develop recreation area at El Yunque Peak, and the PR Road 191 corridor are the zones with more potential for direct effects to the environment by means of trash, vegetation trampling, soil compaction and erosion, direct use of water streams by visitors, and human waste from an estimated 1.2 million visitors per year. In addition, the vehicles used to access these areas can affect the water, soil, and air resources. The proposal to initiate management by capacity with strong emphasis on sustainability is expected to greatly reduce or inhibit direct effects to the environment. Maintenance protocols to structures and facilities in these management areas need to be revised to avoid impacts to the functional wetlands of El Yunque. Best management practices and other mitigating measures will reduce the effects of the impacts to the resources. See other sections for more detailed effects to the resources.



Map 3-16. Alternative 2 management areas

Source: Forest Service Planning Maps (2016).

Most trails have been damaged by recent hurricanes (the most recent being hurricane María) and/or visitors deviating from the main trail that need erosion control measures while plans for repair or mitigations are initiated.

Cumulative Effects

The time scale of this analysis is of 15 years or the life of the plan. The cumulative effects analyzed for the functional wetland are based on management practices within the Forest boundary. Overall, there would be no significant impacts to the functions of wetlands with the implementation of alternative 1 or 2.

Mature Forest

Effects

There would be no potential for direct effects to the mature forest with the implementation of alternative 2. Most of this Forest is protected under designated lands and those outside are protected by means of standards and guidelines that calls to total preservation of the mature forest.

Cumulative Effects

There would be no cumulative effects to the mature forest with the implementation of alternative 2. The time scale of this analysis is of 15 years or the life of the plan. The cumulative effects analyzed for the

mature forest are based on management practices within the Forest boundary; although under new regulations which use collaboration and the "all-lands" approach could assist in mitigating effects.

Overall there would be no significant effects to the mature forest with the implementation of this alternative.

Montane Wet Secondary Forest

Effects

In alternative 2, CIRMA (7,187 acres) is located in this forest type. It provides areas and sections of the Forest where an assortment of resource management practices could be applied to encourage tropical forest management initiatives in the broader landscape of El Yunque. Proposed activities could include sustainable native forest products, applied management strategies, dispersed or develop recreation, forest restoration projects, watershed improvements, wildlife habitat improvement, riparian zones restoration, shared stewardship interface areas, aquatic habitat improvement, and the interpretation of cultural icons recognized in the selected areas.

Even though there are standards and guidelines to protect the montane wet secondary forest, part of this type is located where proposed projects might affect these forests. There would be the potential for impacts to the following resources: watersheds, riparian zones, aquatic habitats and species, flora and fauna, soil, species of conservation concern, recreation, scenery, ecological services, forest products, including wood products. Effects to these lands with the implementation of the potential projects allowed in these management areas include soil erosion and compaction, streams sedimentation, wildlife disturbance, habitat for flora and fauna disturbance and reduction, diversity, scenic values, vegetation and habitat for species of conservation concern. See other sections for more detailed effects to the resources.

Potential impacts from implementing alternative 2 are related to increased recreation activities, recovery of species and diversity, recovery of forest crown cover, recovery of appropriate habitat for plants and animals, soil recovery and potential encroachment of invasive species.

Cumulative Effects

The implementation of several of these projects in the same watershed over time definitely risks the impairment of watersheds of the Forest. The time scale of this analysis is of 15 years or the life of the plan. The cumulative effects analyzed for the montane wet secondary forest are based on management practices within the Forest boundary; although under new regulation, using collaboration and the "all-lands" approach could assist in mitigating effects.

Overall, alternative 2 has potential to affect several resources if implemented in these lands without appropriate mitigation.

Riparian zones

Effects

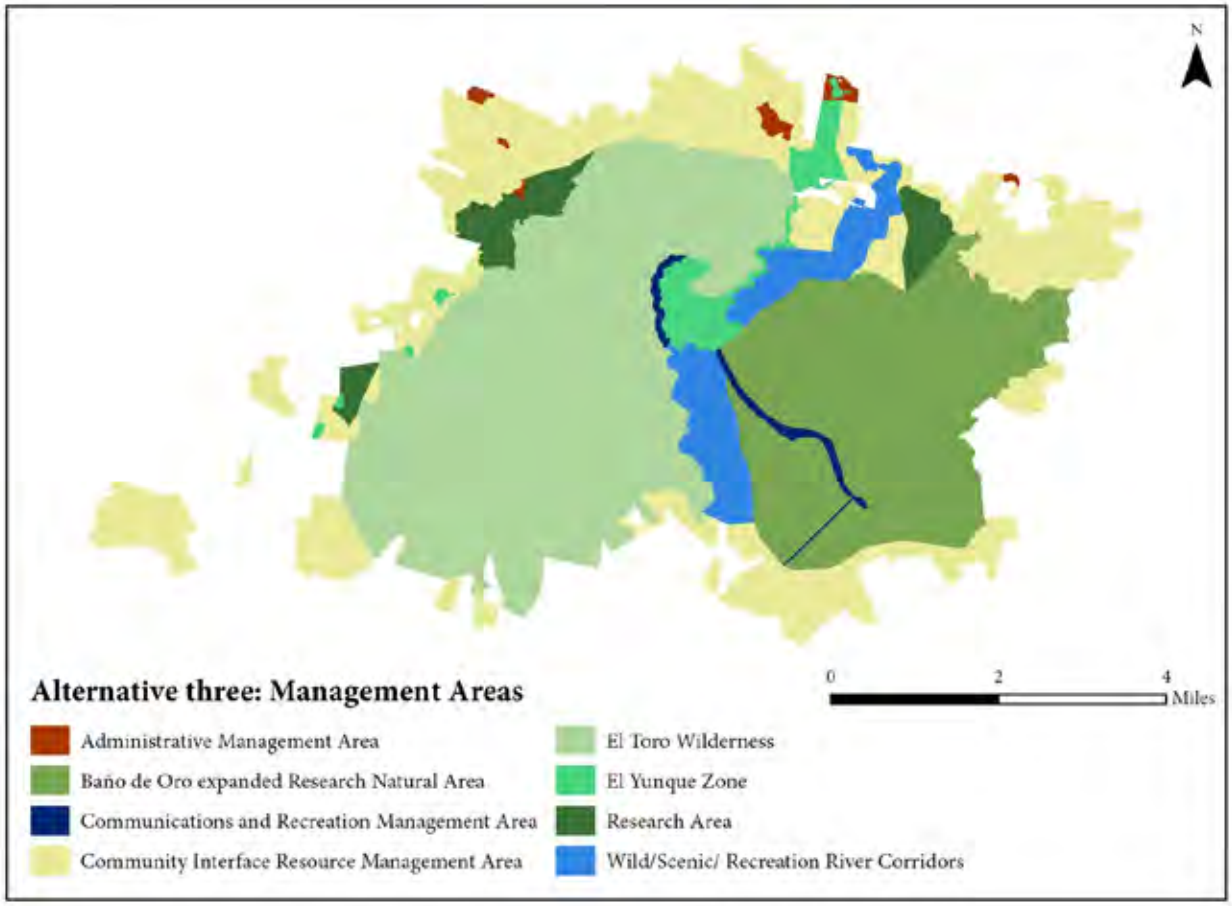
The potential developed recreation sites proposed under alternative 2 are mostly associated with a stream which is the preferred feature in the location of the sites. Visitors to developed recreation sites prefer to wade in water and recreate in the riparian zone when other facilities are full or want to interact with the Forest outside the picnic shelters. Many are developed for the use of the water environment. Dispersed recreation in the CIRMA and other potential activities proposed could also impact the riparian area if the site is heavily visited or intensively used. The resources expected to be impacted are water quality, aquatic habitat and species, wildlife, the soil and the riparian vegetation. Trash generated by visitor and the proper handling of it is another impact to the environment in high visited sites.

The potential for indirect impacts are associated with the soil erosion and compactation, vegetation trampling, change in vegetation composition, and fine sediments movement into the water channel. See other sections for a more detail effects to the resources.

Cumulative Effects

The sources of cumulative effects may occur from road and trail maintenance, recreation, fluctuating human population and the stress this creates on the natural resources. Cumulatively, environmental consequences to the riparian from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall, the cumulative effects of all management actions over time are not expected to adversely affect the riparian zones.

Alternative 3



Map 3-17. Alternative 3 management areas

Source: Forest Service Planning Maps (2016)

Functional Montane Wetland

Effects

Under alternative 3, most of the lands above the 600-meter altitude line (functional wetland) are assigned to El Toro Wilderness, wild and scenic river corridors and recommendation for designation of Baño de Oro Wilderness (changing the research natural area designation of those lands) (management areas that are protected designated lands).

The management areas for communication and recreation at El Yunque Peak, Road 186 and El Yunque Zone are the areas with more potential of direct effects to the environment by means of trash, vegetation trampling, soil compaction and erosion, direct use of water streams by visitors, and human waste by an estimated 1.2 million visitors per year. In addition, the vehicles used to access these areas can affect the water, soil, and air resources. The proposal to initiate management by capacity with strong emphasis on sustainability is expected to greatly reduce or inhibit impacts to the environment. Maintenance protocols to structures and facilities in these management areas need to be revised to avoid impacts to the functional wetland of El Yunque. See other sections for more detailed effects to the resources.

Most trails have been damaged by recent hurricanes (the most recent being hurricane María) and/or visitors deviating from the main trail that need erosion control measures while plans for repair or mitigations are initiated.

Cumulative Effects

There are no cumulative effects expected to the functional wetland with the implementation of alternative 3 over the life of the plan. The cumulative effects analyzed for the functional wetland are based on management practices within the Forest boundary; although under new regulation, using collaboration and the "all-lands" approach could assist in mitigating effects.

Overall, there would be no significant impact to the functions of the wetlands of El Yunque with the implementation of alternative 3.

Mature Forest

Affected Environment

The largest block of mature forests in Puerto Rico is in El Yunque, an area of approximately 13,700 acres.

Effects

There would be no potential for direct effects to the mature forest with the implementation of alternative 3. Most of this forest is protected under designated lands and those outside are protected by means of standards and guidelines that call to total preservation of the mature forest.

There would be no cumulative effects to the mature forest with the implementation of alternative 3. The time scale of this analysis is of 15 years or the life of the plan. The cumulative effects analyzed for the mature forest is based on management practices within the Forest boundary; under new regulation, using collaboration and the "all-lands" approach could assist in mitigating effects.

Overall, there are no significant effects to the mature forest with the implementation of this alternative.

Montane Wet Secondary Forest

Effects

In alternative 3, the Community Interface Resource Management Area (CIRMA) (7,187 acres) is located in this forest type. It provides areas and sections of the Forest where an assortment of resource management practices could be applied to encourage tropical forest management initiatives in the broader landscape of El Yunque. The considered activities could include sustainable forest products, applied management strategies, dispersed or developed recreation, forest restoration projects, watershed improvements, wildlife habitat improvement, riparian zones restoration, shared stewardship interface areas, aquatic habitat improvement, and the interpretation of cultural icons recognized in the selected areas.

Even though there are standards and guidelines to protect the montane wet secondary forest, part of the Forest is located where proposed projects might affect those Forests. There is potential for impacts to the

following resources: watersheds, riparian zones, aquatic habitats and species, flora and fauna, soil, species of conservation concern, recreation, scenery, ecological service and forest products, including wood products. Effects to these lands with the implementation of the potential projects allowed in these management areas include soil erosion and compaction, stream sedimentation, wildlife disturbance, habitat disturbance and reduction for flora and fauna, diversity, scenic values, vegetation and habitat for species of conservation concern. See other sections for more detailed effects to the resources.

Potential effects from implementing alternative 3 are related to increased recreation activities, recovery of species and diversity, recovery of forest crown cover, recovery of appropriate habitat for plants and animals, soil recovery and potential increment of invasive species (20 more acres than alternative 2).

The implementation of several projects in the same watershed over time definitely risks the impairment of watersheds of the Forest. The time scale of this analysis is 15 years or the life of the plan. The cumulative effects analyzed for the montane wet secondary forest will be based on management practices within the Forest boundary; although under new regulation, using collaboration and the "all-lands" approach could assist in mitigating effects.

Overall, alternative 3 has potential to affect several resources if implemented in these lands without appropriate mitigation.

Riparian zones

Effects

The developed recreation potential sites proposed by alternative 3 are mostly associated with a stream which is the preferred feature in the location of the sites. The resources expected to be impacted are water quality, aquatic habitat and species, wildlife, the soil and the riparian vegetation. Trash generated by visitors and the proper handling of it is another impact to the environment in high visited sites. See other sections for more detailed effects to the resources.

Potential impacts are associated with soil erosion, compaction of soil, vegetation trampling, vegetation composition change and fine sediments movement into the water channel.

Cumulative Effects

The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population and the stress this creates on the natural resources. Cumulatively, environmental consequences to the riparian from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall, the cumulative effects of all management actions over time are not expected to adversely affect the riparian zones.

Table 3-17. Determination of effects for all alternatives

	Alternative 1	Alternative 2	Alternative 3
Functional Wetland	Potential effects	Potential effects	Potential effects
Mature Forest	Potential effects	Low potential effects	Low potential effects
Montane Wet Secondary	Potential effects	Potential effects	Potential effects, greater acreage than alternative 2
Riparian zones	Potential effects	Potential effects	Potential effects

3.4.2 Aquatic Ecosystems

3.4.2.1 Affected Environment

El Yunque aquatic ecosystem environment can be defined by two elements: (1) the types of streams and rivers that occur in the planning area; and (2) the composition and structure of aquatic faunal communities that persist in El Yunque streams. Water quality is generally considered high due to little sedimentation or man-made point sources of pollution, especially befire hurricanes Irma and María. The steep mountains in the Forest were formed by volcaniclastic and igneous rocks that exert a strong localized lithologic influence on the stream channels. Longitudinal profiles also show the influence of multiple rock types. Landslides along steep hillslopes (over 12 degrees), deliver coarse sediment (over 2,000 millimeters) to the channels and also may influence channel gradient and geometry (Pike 2008). New landslides occurred after hurricanes Irma and María into channels and adjacent to channels, delivering stream forming pulses of fine to coarse sediment. Although the sediment levels increased after the hurricanes, these increases are within the range of the natural disturbance regime and are important for natural episodic stream forming functions.

Aquatic ecosystems in El Yunque also have steep gradients, channels lined with coarse boulder-sized sediment, numerous bedrock cascades, and abrupt waterfalls (up to 30 meters in height) (Ahmad et al. 1993). First-order perennial streams have bouldered channels in steeply sloped reaches, and clay and soil-lined channels in reaches with more gentle slopes. Second- and third-order streams have steep gradient reaches, exposed bedrock channels, large boulders, and periodic waterfalls. Due to rapid decomposition, before hurricanes Irma and María, these channels lacked the large coarse woody debris dams that created aquatic habitat in many channels in humid temperate environments (Covich and Crowl 1990). The hurricanes resulted in a pulse of woody debris contributions to aquatic habitat. Numerous new woody debris slumps to dams have been found during after hurricane initial surveys. Fourth and fifth-order (wide and slow moving waters) streams occur only at the lower elevations along the coastal plain, which is outside of El Yunque. Most habitats are categorized as either pools or riffles.

The second element of the affected environment consists of the biological component of the aquatic faunal community. El Yunque common aquatic species include the following species that act as first-level and second-level consumers: nine common freshwater shrimp species (*Xiphocaris elongata*, *Atya lanipes*, *Atya scabra*, *Atya innocuous, Micratya poeyi*, *Macrobrachium faustinum*, *Macrobrachium heterchirus*, *Macrobrachium carcinus*, and *Macrobrachium crenulatum*), one crab species (*Epilobocera sinuatifrons*), and five common fish species (*Sicydium plumieri*, *Awaous banana*, *Agonostomus monticola*, *Anguilla rostrata*, and *Gobiomorus dormitor*). There are no rare or federally listed aquatic species on El Yunque.

Population indices of these aquatic species from long-term monitoring sites conducted by El Yunque show a stable count of common aquatic species on El Yunque. Many of the freshwater shrimp live their entire life cycle within the river systems where they are found. It is the same biological cycle for many of the endemic freshwater fishes with the exception of the American eel (*Anguilla rostrata*). The American eel is a catadromous fish species where adults travel to breeding areas in the Sargasso Sea to the north and the next generation of young eels return to El Yunque streams.

There are no managed sport fishes on El Yunque due to natural conditions proving too challenging with high occurrence of flash flooding and high competition for resources. Invasive aquatic species are insignificant to the aquatic ecosystems at this time. Thus, healthy native aquatic species populations provide a measurable component of the affected environment for aquatic ecosystems.

Alternative 1

Desired conditions, objectives and standards/guidelines for the management areas in the 1997 Forest Plan are issue driven. The 1997 management concept focused on a conservation approach with little vegetation management. The planning strategy was for developing solutions to nine issues through plan components.

Current (1997) management area designations would continue following standards and guidelines found in other resource areas such as the water and fisheries component of the wildlife section. These standards and guidelines make reference to what is now specifically known as "aquatic ecosystems through reference to maintenance of different ecological components" and "provide protection from actions near this ecosystem."

Long-term implementation of the plan would result in the continued functioning and protection of all federally designated rivers, streams, and their respective riparian zones, with robust populations of aquatic species.

Aquatic ecosystem management parameters in this alternative would not reduce resiliency to change. This is based on reviewing 17 years of management using the direction in the 1997 Forest Plan.

Water quality and an appropriate flow regime for aquatic fauna and riparian vegetation would continue to be provided.

Biotic resources would be managed for continued sustainability through cursory monitoring and abiotic conditions would still be collected. Developed recreation facilities would occur adjacent or within aquatic ecosystem zones. Best management practices would still be emphasized for both use and improvements for these human recreational benefits.

Monitoring data that would be collected should provide simple visuals of habitat conditions.

Alternative 2

Desired conditions, objectives, and standards/guidelines for the management areas under this alternative emphasizes social and economic sustainability through a more dispersed recreation strategy, enhancing ecosystem services, continued at-risk species stewardship through high quality habitat conditions, and improved resilience to climate change where possible. Potential effects to aquatic resources would be evaluated based on indices of monitoring variables that are identified in the proposed monitoring plan. Aquatic ecosystems programmatic management would continue to implement best management practices for any management action conducted on the Forest.

In the long term (and cumulatively) the use (small scale) of Forest lands for forest products would enable a more diverse vegetation structure in a management area where plantations were used in the past. Recreation resources would be improved and a strategy to disperse public use would be spread to the periphery of the Forest. Improved at-risk species stewardship is anticipated through a more collaborative process; overall implementation of alternative 2 would improve the aquatic ecosystem.

Alternative 3

Desired conditions, objectives, and standards/guidelines for the management areas in this alternative are the same as alternative 2, with new elements that implement a preservation approach to all resource areas by reducing trails, focusing the scope of invasive species at idientified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats, recommending a new wilderness area, and eliminating the scenic byway. Most of the other similar elements of social and economic sustainability are retained in this alternative. Potential effects to aquatic ecosystems would be evaluated using the monitoring variables that are identified in the proposed monitoring plan. Aquatic ecosystems

management would continue to implement best management practices for any management conducted by the Forest.

Long-term (and cumulative) effects would be similar to alternative 2 in the use of forest products with the additional results of more use on fewer trails and more lands in wilderness category.

3.4.3 Threatened and Endangered Species/Species of Conservation Concern

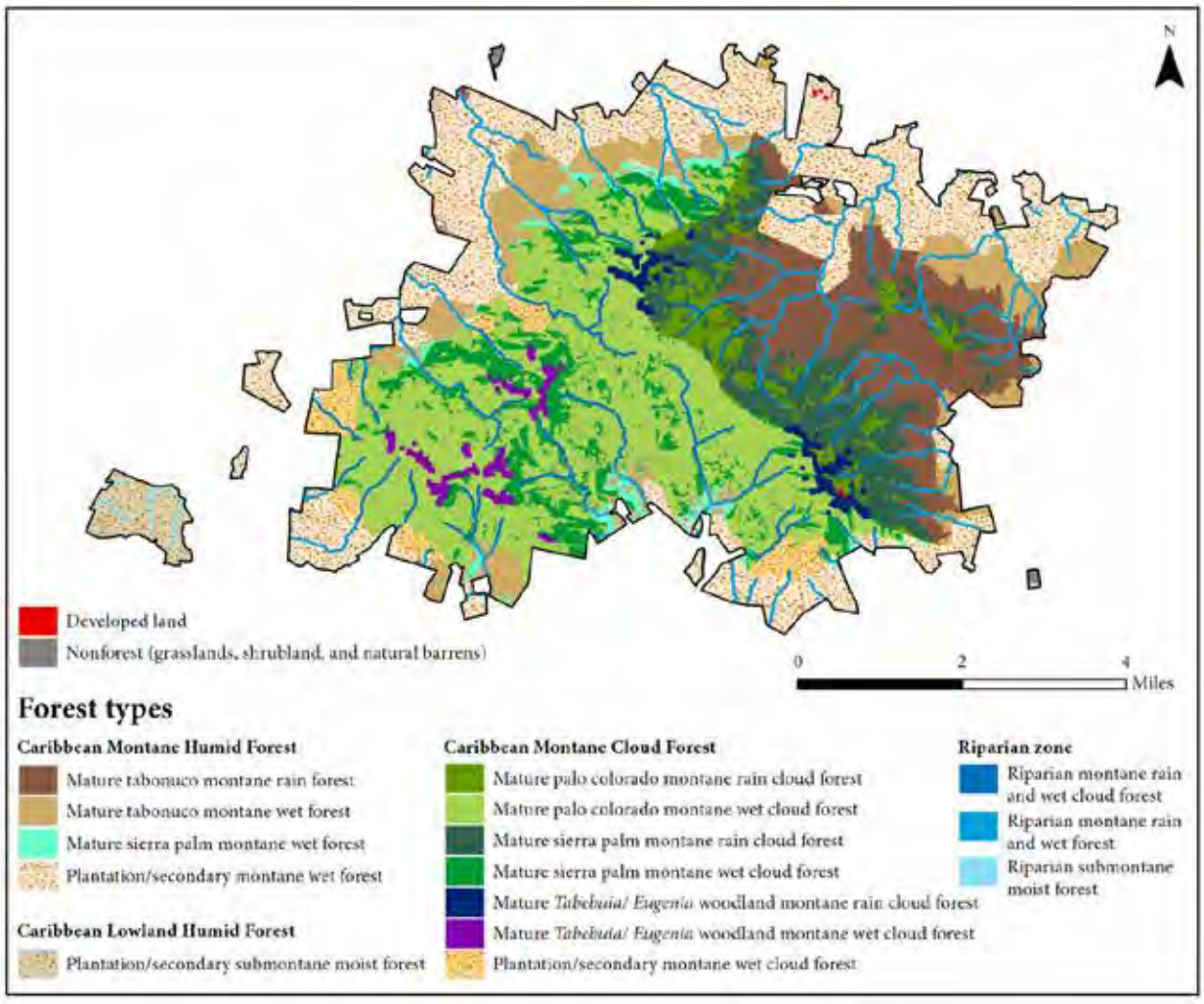
This section covers federally threatened and endangered (T&E) species and any applicable candidate and proposed species, which require protection or consultation under the Endangered Species Act (36 CFR 219.16). The Forest Service cooperates with the United States Fish and Wildlife Service (USFWS) in the identification and evaluation of species likely to be affected and in the development of Forest plan components that contribute to their recovery.

For this section of the document there will be three forms of effects analysis: direct, indirect and cumulative. An effect is often defined as a change measured "by comparing starting and ending points of reference for a specific indicator and relative to some benchmark of magnitude" (Dube et al. 2006). Thus a direct effect is caused by the action that occurs at the same time and place (National Environmental Policy Act, 1969). An indirect effect is caused by the action and occurs later in time or is farther removed in distance, but is still reasonably foreseeable (National Environmental Policy Act, 1969). A cumulative effect is defined as the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions regardless of the agency or person undertaking such other actions.

For specific reference to the Migratory Bird Treaty Act of 1918, there are two species from the 2008 U.S. Fish and Wildlife Service (USFWS) Migratory Bird list for the U.S. Caribbean islands (Puerto Rico and U.S. Virgin Islands). The two species are the Elfin-woods warbler (*Setophaga angelae*) and the Greater Antillean Oriole or the updated name, the Puerto Rican Oriole (*Icterus portoricensis).* The two species are addressed through at-risk fauna species sections due to the status of the Elfin-woods warbler as a Federally-listed species and the Puerto Rican Oriole as a Species of Conservation Concern. Thus, habitat issues are addressed for this Act in the new Forest Plan for El Yunque National Forest.

3.4.3.1 Affected Environment–Threatened and Endangered Species

Six species of federally listed threatened and endangered animal species with ranges occurring in the municipalities of Rio Grande, Luquillo, Naguabo, and Canovanas were included and evaluated in the ecological sustainability evaluation process. Throughout El Yunque, threatened and endangered species protection and habitat enhancement is a priority, so their needs are particularly emphasized. The overall affected environment can be summarized as a tropical rainforest within the Caribbean Basin located between North America and South America. The vegetation on El Yunque is consistent with tropical wet rain forests and is arranged into 15 new vegetation types (see Map 3-18).


N
Developed land
Nonforest (grasslands, shrubland, and natural barrens)
0
2
4
Miles
Forest types
Caribbean Montane Humid Forest
Mature tabonuco montane rain forest
Mature tabonuco montane wet forest
Mature sierra palm montane wet forest
Plantation/secondary montane wet forest
Caribbean Lowland Humid Forest
Plantation/secondary submontane moist forest
Caribbean Montane Cloud Forest
Mature palo colorado montane rain cloud forest
Mature palo colorado montane wet cloud forest
Mature sierra palm montane rain cloud forest
Mature sierra palm montane wet cloud forest
Mature Tabebuia/ Eugenia woodland montane rain cloud forest
Mature Tabebuia/ Eugenia woodland montane wet cloud forest
Plantation/secondary montane wet cloud forest
Riparian zone
Riparian montane rain and wet cloud forest
Riparian montane rain and wet forest
Riparian submontane moist forest

Map 3-18. El Yunque National Forest vegetation

Source: Quiñones, M.; Rivera, L.A.; Gould, W.A. 2013. El Yunque National Forest vegetation map. Terrestrial Ecosystem Assessment chapter of the land and resources management plan revision for El Yunque National Forest. Vector data. USDA Forest Service, San Juan, PR.

Table 3-18. List of federally listed threatened, endangered and candidate species (fauna) on El Yunque

Common Name	Scientific Name	Category	Status
Puerto Rican Parrot	Amazona vittata	Bird	Endangered
Puerto Rican Broad-winged Hawk	Buteo platypterus brunnescens	Bird	Endangered
Puerto Rican Sharp-shinned Hawk	Accipiter striatus venator	Bird	Endangered
Elfin Woods Warbler	Setophaga angelae	Bird	Threatened
Puerto Rican Boa	Epicratus inornatus	Reptile	Endangered
White-necked Crow	Corvus leucognaphalus	Bird	Extirpated from Puerto Rico

3.4.3.2 Environmental Consequences–Threatened and Endangered Species (Fauna)

Forest planning is a 2-tier system consisting of:

- A Forest Plan that provides broad management direction for the next 10 to 15 years, and
- Project-level decisions within the Forest Plan direction.

Forest plan components, such as desired conditions, standards and guidelines, and objectives, provide broad management direction. These Forest Plan components comply with the requirements of the Endangered Species Act of 1973 (ESA) and the associated recovery plan for each federally listed species.

Project-level analysis evaluates site-specific impacts, based on conditions on-the-ground. Additional mitigation measures may be developed, if needed.

In general, all federally listed threatened and endangered species would continue to be managed and protected across the Forest in accordance with Forest Service policy, recommended protection measures in the recovery plans, and all applicable state and Federal laws. Individual projects during the next planning period may result in direct negative effects to an individual, but effects analysis and consultation will take place at the project level should this situation ever occur.

Cumulative Effects, All Alternatives

Public lands play a critical role in the conservation of rare species and native habitats, which sometimes receive little formal protection or conservation on private lands. This is especially true for federally listed plants, which receive no legal protection on private lands. During the next 10 to 50 years of Forest Plan implementation, human populations are likely to either expand or shift to urban areas, affecting present urbanizations, roads, and associated traffic. These trends suggest not only that public lands will play an increasingly important role in the conservation of threatened and endangered species in the future, but also that land management to ensure recovery and/or prevention of Federal listing of species may be increasingly difficult.

For some species such as the Puerto Rican parrot and elfin woods warbler, the Forest Service consistently works beyond the plan area boundary to collaborate and cooperate with U.S. Fish and Wildlife Service (USFWS), Commonwealth of Puerto Rico, and other partners to support an “all-lands” approach to species recovery. The agency has also worked and continues to work with partners to reintroduce at-risk species into historical habitat on National Forest System lands where appropriate.

Thus, the planning components provide sustainable and long-term habitat management for all federally listed species to better meet changes to conditions that may warrant the use of scientific land management options.

Puerto Rican Parrot (Amazona vittata): Endangered

Once widespread throughout the island, the Puerto Rican parrot was reduced to a relict population on El Yunque National Forest, one of few forested areas left on the island by the late 1930s (Brash 1987, Snyder et al. 1987). The Puerto Rican parrot was listed as endangered in 1968. This species is the only native parrot in the United States and it was considered one of the ten most endangered birds in the world. Nearly every aspect of the species’ life cycle, including most biotic interactions (e.g., predators, ectoparasites), have been managed to promote its persistence (USFWS 2009). The bird is not directly associated to a specific habitat on El Yunque National Forest but “Amazona parrots in general are known to range widely within the forest types they inhabit, regularly flying long distances to obtain food” (Snyder et al. 1987).

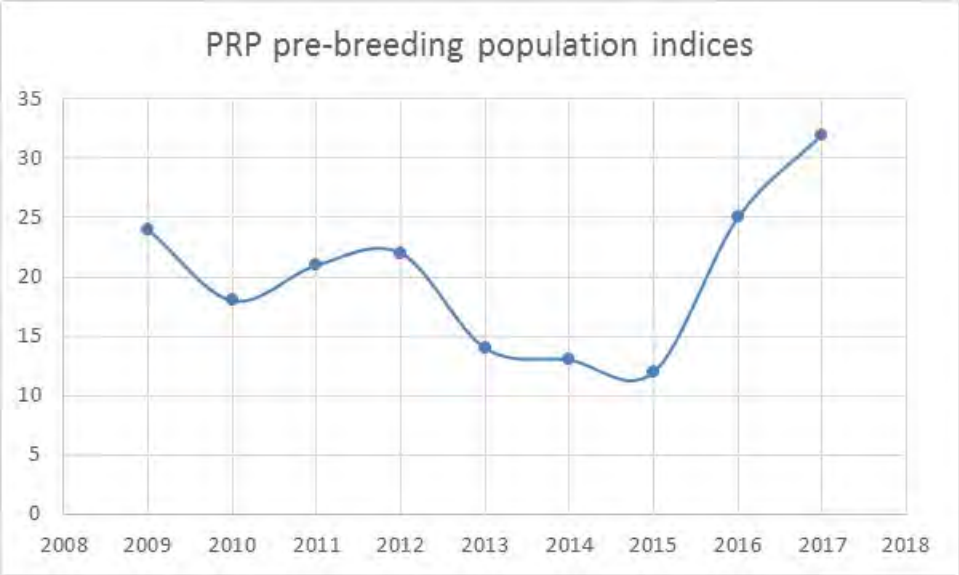


Figure 3-4. Pre-breeding population indices of wild flock of Puerto Rican parrots on El Yunque 2009 to 2017

Note: Pre-breeding Puerto Rican parrots counted during pre-breeding indices (February to April) in El Yunque. Indices are not to be confused with a census that shows the total population size.

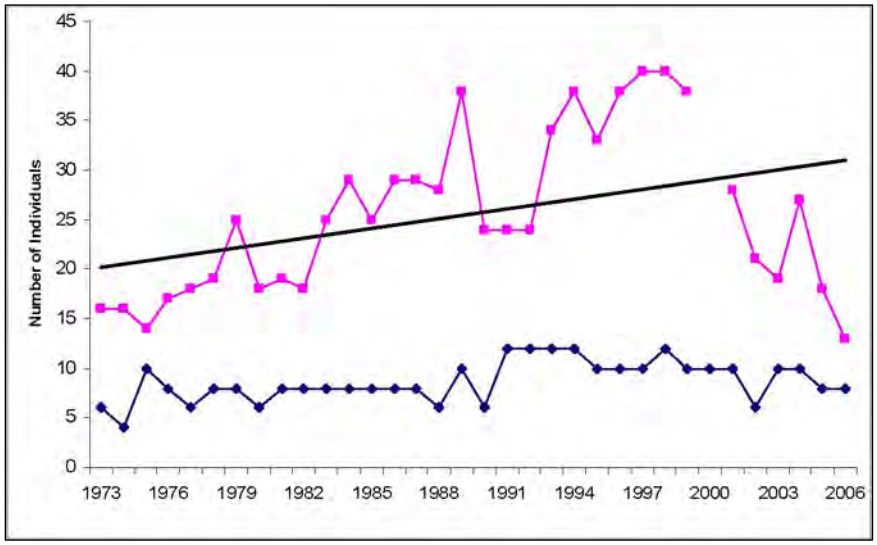


Figure 3-5. Population trend of a wild Puerto Rican parrots on El Yunque 1973 to 2006 (USFWS 2013)

Note: Average Puerto Rican parrots counted during pre-breeding indices (March and April) in El Yunque. Pink is adults and blue is young parrots.

Before the 2017 hurricanes there were 53 to 56 wild individuals in El Yunque National Forest and 134 wild individuals in the Río Abajo Forest in north central Puerto Rico. After hurricanes Irma and María, the number of known alive wild individuals reduced to 3 to 11 and 104 respectively. Two combined captive population aviaries hold more than 350 individuals: the Iguaca Aviary and the José L. Vivaldi Aviary in El Yunque National Forest and Rio Abajo state forest, respectively. The species was at 13 individuals in 1976 and a total population, including captive birds, at approximately 500 individuals before the 2017 hurricanes (Velez 2016). According to a population viability analysis (2003) the Puerto Rican parrot is still slowly coming out of a genetic bottleneck. Interagency efforts have been addressing population growth limitations to move towards a viable status for the parrot. The interagency recovery effort has also realized that El Yunque National Forest is not the optimal habitat for the Puerto Rican

parrot. A more successful population may be established by introducing a third wild flock in more suitable habitat on the western side of Puerto Rico (White et al. 2014).

Figure 3-4 illustrates the annual variability in El Yunque National Forest parrot population. Trend variation can be explained through varying effects from predation, hurricanes, genetic bottleneck, and local climatic factors which limit population growth (White et al. 2014). Overall El Yunque National Forest population had an increasing trend since 1973 prior to the 2017 hurricanes, see figure 3-4 and figure 3-5.

Alternative 1

The 1997 Forest Plan focused on the recovery of the Puerto Rican parrot. Therefore, many management activities were restrained under the assumption that those habitats were vital for the recovery of the parrot. However eventually the parrot population dwindled over time due to limiting population factors, including the limited amount of actual optimal habitat.

The population is no longer expected to grow significantly on El Yunque, but still functions as an important resource for the successful recovery outside of El Yunque in more preferred habitat. Population and active nest data can be interpreted that levels will be either rising or falling, but remaining within a range.

Planning components continue to provide protection to identified habitats that are in use and provide consideration in relation to other management uses.

Alternative 2

There would be a continued emphasis on parrot recovery with partners throughout identified habitat with planning components to manage any new suitable habitat use (e.g., nesting availability, population limiting factors control, enforced area closure of Forest Service Road 12 and competing land management use guidance). This allows for an ample degree of adaptive management for accumulating scientific data on the biology of the parrot.

An increased ability to improve resiliency to climate change through wildlife stand improvement components after a naturally occurring event and the monitoring of any new wildlife interactions will further assist in protecting the local Puerto Rican parrot population.

Alternative 2 includes a new scenic byway (PR Road 186) in the western portion of El Yunque, where there is high quality habitat for the parrot. Designation of this scenic byway ensures that future management projects will ensure high quality habitat continues to persist through the maintenance of the values of the new scenic byway.

Regarding the establishment of Community Interface Resources Management Area (CIRMA), activities for sustainable resource use are not exempted from any wildlife and fisheries planning components. This ensures that if any parrot use (foraging or nesting) is found immediately within this new or any other management area, it will be a management priority.

Alternative 3

The potential for direct effects to the Puerto Rican parrot would be the same as in alternative 2. However, indirectly, the exclusion of the new scenic byway would not create any potential increase of management of the right-of-way in the PR Road 186 area (in the northwest portion of El Yunque). This would increase the beneficial use by the parrot if it flies off El Yunque lands through the western portion. The benefit

would be minor due to knowledge that the activity would not create a significant change in Puerto Rican parrot behavior through this land use designation.

Cumulative Effects

Puerto Rican parrot habitat would continue to be maintained and enhanced in all alternatives, as it has been since the 1997 Forest Plan was implemented.

In alternatives 2 and 3, cumulative effects from the creation of the CIRMA and scenic byway may increase human presence in the form of diverted recreational use at small recreation areas (e.g., picnic sites, vistas) or small-scale use of sustainable agroforestry for the surrounding community. The CIRMA points of interest are located in the north, east, and southern periphery of El Yunque and are specifically meant to be small scale to ensure intact ecological services. Any interested group would be instructed to report any Puerto Rican parrot immediately to El Yunque and monitoring of those areas by El Yunque personnel would provide continued stewardship of the habitat.

The scenic byway would, over time, increase vehicular use in alternative 2; thus, it is expected that there would be an increase of potential noise from vehicular and human presence in any rehabilitated recreation site. The intent of the scenic byway is that it is meant to be used as a travel route through El Yunque in its western section. The designated management area is over 100 meters away in most areas to El Toro Wilderness Area, and provides a buffer, due to the dense vegetation structure of the tropical rainforest. These and other planning components do provide for the project-level analysis, a strong foundation for any mitigation that may be needed at the project-level.

Puerto Rican Broad-winged Hawk (Buteo platypterus brunnescens): Endangered

The Puerto Rican broad-winged hawk was federally listed as endangered in 1994. This hawk is an endemic woodland raptor of upland montane forests of Puerto Rico (Hengstenberg and Vilella 2005). It is a subspecies of the broad-winged hawk. Breeding in Puerto Rico begins in late December, with nests placed in the upper reaches, but below the high canopy (Delannoy and Tossas 2002). This species occurs in Elfin Woodland, Sierra Palm, Caimitillo-Granadillo, and Tabonuco Forest type of the Rio Abajo Commonwealth Forest (Western Puerto Rico), Carite Commonwealth Forest (Southeastern Puerto Rico), and El Yunque (USFWS 2010). The raptor is known to prefer forest types with an open mid-story vegetation structure to prey on species such as lizards and small birds. The broad-winged hawk in Puerto Rico is non-migratory and exhibits a limited geographic range with all known populations restricted to montane forests (Delannoy 1997). The hawk's population was estimated at about 125 individuals Islandwide in 1994 (USFWS 2010). There have been very few observations of the broad-winged hawk in annual bird counts, but it is known to still exist on El Yunque.

Table 3-19. Present observation trend of the Puerto Rican broad-winged hawk (Delannoy 1992)

Forest	Census Area (km2)	Number of Hawks	Estimated Population
Luquillo (El Yunque)	206.4	58	124

The Puerto Rican broad-winged hawk's density and population estimates varied considerably among forests, being highest at Rio Abajo Forest and lowest in El Yunque National Forest (Delannoy 1995). As far as current Puerto Rican broad-winged hawk population indices in El Yunque National Forest, there are none. Unfortunately, observations and anecdotal references exhibit substantial concern for a renewed effort toward population surveys and aligning with relevant land management agencies to address the recovery plan on this species.

Dr. Francisco Vilella´s understanding of this species' conditions are the following: "they [PRBWHA] have gone from six or more breeding territories during my time in the Puerto Rican parrot project to a single pair sighted near El Toro" (Vilella, 2016).

Alternative 1

In alternative 1, the hawk's habitat would continue to be maintained and enhanced as it has since the 1997 Forest Plan was written. The direction of this management area would continue to protect the species and its habitat, providing a naturally driven vegetative structure. However, without more direction to stimulate reproduction the Puerto Rican broad-winged hawk population would stay constant or trending towards decline.

Alternative 2 and 3

Alternatives 2 emphasize the evaluation of the new scenic byway (PR Road 186) in the western portion of El Yunque, while alternative 3 doesn't consider this possibility. This would be expected to improve management efforts providing high quality habitat for the species and other species of this system (restoring ecological functions after a natural disaster, for example). Intrinsically, alternatives 2 and 3 would be expected to provide the greatest amount of benefits and protection for the Puerto Rican broad-winged hawk. These alternatives provide new tools for partnerships with academic institutions and others to continue collecting scientific information on the species.

Cumulative Effects

Cumulative effects may take the form of the shifting human population and stresses on the natural resources of El Yunque. There may be various degrees of partnership opportunities that all of these alternatives present to work on behalf of this species. The new Northeast corridor would provide a link between the Forest and the coastal region of Northeast Puerto Rico, which may present a variety of habitat for the species.

Puerto Rican Sharp-shinned Hawk (Accipiter striatus venator): Endangered

The Puerto Rican sharp-shinned hawk, a subspecies of the sharp-shinned hawk, was designated a federally endangered species in 1994. There are more individuals outside of El Yunque National Forest, but a survey by Delannoy (1992) reported only a solitary territorial hawk pair in the southcentral part of the Forest. This area is located within the Palo Colorado Forest type in the Lower Mountane Forest Life Zone (Ewel and Whitmore 1973). Historically, sixty individuals of Puerto Rican sharp-shinned hawks were counted in Island-wide surveys conducted in 1983, and a breeding density of 0.73 hawks per square kilometer was estimated (Cruz and Delannoy 1986). In 1985, 72 individuals were counted and a breeding population of 0.76 hawks per square kilometer (230 to 250 Island-wide) was estimated in Island-wide surveys (Cruz and Delannoy 1986). In 1992, a total of 285.6 square kilometers was surveyed yielding 82 sharp-shinned hawks: 80 outside of El Yunque National Forest and 2 within El Yunque National Forest.

The hawk prefers an open mid-story vegetation structure for its preferred prey species of lizards and small birds.

As of late, available information on the Puerto Rican sharp-shinned hawk indicates populations are small and mostly restricted to montane forest reserves; virtually no information exists of Puerto Rican sharp-shinned hawk on private lands.

According to Gallardo (2014), all Caribbean subspecies appear to be declining and the Puerto Rican sharp-shinned hawk has exhibited a population reduction of 40 percent on public lands. "Recent field work and censuses suggest they [Puerto Rican sharp-shinned hawk] have been extirpated in the Maricao

Forest and potentially isolated in the rest of their range to a few montane reserves" (Gallardo and Vilella, 2014).

Table 3-20. Average density and estimated population of the Puerto Rican sharp-shinned hawk (Delannoy 1992)

Forest	Census Area (km^2)	Number of Hawks	Average Density ±S.E.	Min-max	Estimated population +S.E.
Luquillo (El Yunque)	285.6	82	-	-	129

Alternative 1

In alternative 1, the hawk's habitat would continue to be maintained and enhanced as it has since the 1997 Forest Plan was written. The direction of this management area would continue to protect the species and its habitat, providing a naturally driven vegetative structure. However, without more direction to stimulate reproduction, the Puerto Rican sharp-shinned hawk population would stay constant.

Alternative 2 and 3

These alternatives would have the following direct and indirect effects. Alternative 2 has an emphasis on the evaluation of the new scenic byway (PR Road 186) in the western portion of El Yunque. This would be expected to improve management efforts providing high quality habitat for the Puerto Rican sharp-shinned hawk and other species of this system (restoring ecological functions after a natural disaster, for example). Intrinsically, alternative 2 and 3 would be expected to provide the greatest amount of benefits and protection for the species. These alternatives provide new tools for partnerships with academic institutions and others to continue collecting scientific information on the species.

Cumulative Effects

Cumulative effects may take the form of the shifting human population and stresses on the natural resources of El Yunque. There may be various degrees of partnership opportunities that all of these alternatives present to work on behalf of this species. The new Northeast corridor would provide a link between the Forest and the coastal region of Northeast Puerto Rico, which may present a variety of habitat for use of species.

Elfin-Woods Warbler (Setophaga angelae): Threatened

The Elfin-woods warbler was listed as a threatened species in June 2016. The species is endemic to Puerto Rico and has been reported in humid montane forest habitats. Initially thought to occur only in the Luquillo Mountains (El Yunque National Forest), this species was later discovered in the Maricao, Toro Negro, and Carite State forests (Gochfeld et al. 1973; Cruz and Delannoy 1984a; Raffaele 1998). Kepler and Parkes (1972) described the elfin-woods warbler from the high elevation Elfin Woodland Forests (2,099 to 3,378 feet) even though they were also found in Palo Colorado Forests on El Yunque National Forest. Wiley and Bauer (1985) later reported the species from the Elfin Forests and lower elevation forests (1,213 to 1,968 feet) such as Palo Colorado and Sierra Palm forests in El Yunque National Forest. According to Arendt (2013), "since its discovery and classification there has been concern regarding the status and future of this species due to its limited range and dwindling habitat and predicted repercussions of escalating climate change.

Recent published studies on El Yunque National Forest conducted by Arendt (2013), included bird surveys that follow 30 transect points in each forest type in two days (15 points per day) between 05h30 and 09h30 AST (Atlantic Standard Time). Surveys were conducted approximately monthly from 1989 to

2006. To minimize observer bias, three field biologists conducted most of the surveys over the 17-year period. By determining EWWA population density, Arendt (2013) documented its continuous decline in eastern Puerto Rico. The species showed a significant general declining trend from approximately 0.2 individuals/ha in 1989 to approximately 0.02/ha in 2006 in elfin woodland, and from 1 to 0.2 in palo colorado forest types.

The USFWS has completed a candidate conservation agreement (CCA) with El Yunque National Forest in 2014 because this forest is one of the last two locations in Puerto Rico where the warbler is found. The candidate conservation agreement is summarized as a binding agreement between the USFWS, Puerto Rico Department of Natural and Environmental Resources, and the US Forest Service-El Yunque National Forest in five conservation themes. These themes are strategic conservation actions, habitat restoration, species' ecology, monitoring, and education/outreaches. Each agency partner are expected to commit in their own legal authority and report to a technical team dedicated to the species' status.

Alternative 1

In alternative 1, the elfin-woods warbler habitat would continue to be maintained and if possible enhanced. Although this species is not specifically mentioned for management concerns, it is known indirectly as a species of which to be aware.

Management areas such as El Toro Wilderness Area (MA-5) and Baño de Oro expanded Research Natural Area (MA-7) would resume protective standards and guidelines.

Although this alternative contains an emphasis on retaining a natural vegetation composition and structure, the plan would not build the resilience of the habitat against climate change or changes in human activity (e.g., recreation pressures) that may prove detrimental over the long term. These long-term conditions may take the form of degrading foraging and nesting habitats, which may limit population growth and expansion of the species on El Yunque.

Alternative 2 and 3

With emphasis on increased ecological/economic sustainability, conditions of the habitats occupied by the elfin-woods warbler would improve due to a higher priority on habitat management. Scientific knowledge is being accumulated over this species' biological needs and these alternatives would foster the partnership with academic institutions to evaluate ecological and economic value. The desired conditions for "at risk" species includes the need for metapopulation management. This means a collaboration with partners outside of El Yunque to reach goals both in and outside of the planning area.

These alternatives also included standards and guidelines specific to this species needs in moving it toward a viable population. Including a management area's map in the new Forest Plan would confirm the priority of all management uses to take into considerations of this little-known warbler's biological needs.

In the following photos, note the high quality of the Elfin woodlands (mature *Tabebuia/Eugenia* woodland wet cloud forest) and palo colorado (wet and rain). These alternatives would allow a more adaptive approach to improve the species' habitat. In other words, if a degree of variation does occur from these baseline conditions, El Yunque would scientifically attempt to find the source of the change and determine how to address it.

Figure 3-6. Desired Elfin woodlands (mature *Tabebuia/Eugenia* woodland montane wet cloud forest) (left); desired Palo Colorado forest type (right)

Puerto Rican Boa (Epicratus inornatus): Endangered

Listed as an endangered species in 1970, this boa is found mostly in the northern half of the Island of Puerto Rico. Wiley (2003) collected data from 1973 through 1986 and reported several new localities to the PR boa distribution, also showing that boas are widespread in Puerto RicoWunderle et al (2004) studied habitat use of the boa in El Yunque National Forest and indicated that, although the boa were located in a variety of microhabitats (i.e., vine enclosed broadleaf trees shrubs, vine tangles, bamboo, dead trees, buildings and streams), the boa mostly occurred in broadleaf trees followed by ground or below-ground sites. This radio telemetry study by Wunderle at El Yunque National Forest monitored 24 snakes with a total 70 tagged Puerto Rican boas with transponders (pit-tags). Boas were found incidentally during daylight and evening hours while walking or driving to sites with radio-marked boas. According to Wunderle et al. (2004), much of the boa's apparent rarity is related to the observer's ability to visually detect this cryptic species within the forest. As an example, Wunderle et al. (2004) failed to visually detect telemetry-tracked boas an average of 85 percent of their telemetry relocations. Given this detection difficulty in the forest, it is likely that the species is more abundant than generally perceived. According to the findings of Wunderle et al. (2004), habitat use differed significantly among sexes with females spending more time on or below ground than males. "Thermoregulation requirements of gravid females may contribute to use of exposed terrestrial debris piles (Wunderle et al. 2004).

The Puerto Rico Gap Analysis Project developed an occurrence map and predicted distribution map of the Puerto Rican Boa (Gould et al., 2008). This map illustrates that the known occurances of the boa are highly scattered and fragmented across northern Puerto Rico, but the predicted probable distribution is island wide.

Alternative 1

Under alternative 1, the boa's habitat would continue to be maintained and enhanced as it has since the 1997 Forest Plan was written. The direction of this management area would continue to protect the species and its habitat providing a naturally driven vegetative structure. However, without more direction to stimulate reproduction and survival, the Puerto Rican boa population would remain as is.

Alternative 2

Alternative 2 emphasizes the construction of the new scenic byway (PR Road 186) in the western portion of El Yunque. There would be an increase in vehicular travel and individuals may be affected. However, the habitat of the species as a whole will still remain functioning and contributing to a sustainable population.

Alternative 3

Alternative 3 would be expected to provide the greatest amount of benefits and protection for the Puerto Rican boa. This may be due to the restoration of habitat after natural disasters that would be expected to provide high quality habitat for the species. Also, the absence of the new scenic byway (PR Road 186) would reduce the risk to individuals. This alternative also provides new tools for partnerships with academic institutions and other partners to continue collecting scientific information on the species' biological and behavioral trends.

Cumulative Effects

Cumulative effects may take the form of the shifting human population and stresses on the natural resources of El Yunque. There may be various degrees of partnership opportunities that all of these alternatives present to work on behalf of this species. The new Northeast corridor would provide a link between the Forest and the coastal region of Northeast Puerto Rico, which may present a variety of habitat for use by the species.

White-necked Crow (Corvus leucognaphalus): Extirpated from Puerto Rico

The endangered white-necked crow no longer exists on the Island of Puerto Rico, but still occurs in neighboring Dominican Republic (Island of Hispaniola). The bird had an original range of both of the Greater Antilles Islands (Puerto Rico and Hispaniola), but over time was confined to only one Island. Due to considerable lowland forest clearance and hunting, the species was last seen in Puerto Rico in 1963. There is a low potential for reintroduction of this species, but El Yunque would be a likely location for its recovery.

There will be no analysis of trends or drivers for this species since the species does not occur on the Island of Puerto Rico as unofficially accepted by Federal and state land managing agencies.

3.4.3.3 Species of Conservation Concern

The ecosystems of the tropical rainforests support the largest biodiversity on the planet. The planning team evaluated ecological conditions on El Yunque to provide for species diversity using a coarse-filter/fine-filter approach. Most plant and animal species on the Forest will be sustained by maintaining and restoring the composition, structure, function and connectivity of a diversity of ecosystems in the plan area.

Where needed, the team developed fine-filter strategies to contribute to the recovery of threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern—all collectively called "at-risk species."

To assess species diversity, a comprehensive list of plant and animal species was compiled as part of El Yunque National Forest Plan Assessment by combining species lists from a variety of sources, including the following:

- Federally listed threatened and endangered species obtained from the USFWS;
- State species of conservation from the Puerto Rico Natural Heritage Program, State Comprehensive Wildlife Conservation Strategy;
- Birds of conservation concern compiled by the USFWS; and
- The Forest Service's list of sensitive species.

Additional species were added based on input from recognized conservation experts within the state. All species were considered in the design of ecological conditions within the plan area.

Table 3-21. Species of conservation concern (fauna – 23 species)

Taxonomic Group	Taxonomic Subgroup	Species	Common Name
Amphibian	Frog	Eleutherodactylus brittoni	Grass Coqui
Amphibian	Frog	Eleutherodactylus eneidae	Eneida's coqui
Amphibian	Frog	Eleutherodactylus gryllus	Cricket coqui
Amphibian	Frog	Eleutherodactylus hedricki	Hedrick's coqui
Amphibian	Frog	Eleutherodactylus karlschmidti	Web-footed coqui
Amphibian	Frog	Eleutherodactylus locustus	Locust coqui
Amphibian	Frog	Eleutherodactylus portoricensis	Upland coqui
Amphibian	Frog	Eleutherodactylus richmondi	Richmond's coqui
Amphibian	Frog	Eleutherodactylus unicolor	Dwarf coqui
Amphibian	Frog	Eleutherodactylus wightmanae	Melodius coqui
Aquatic	Eel	Anguilla rostrata	American eel
Aquatic	Fish	Awaous banana	Yellow river goby
Aquatic	Fish	Dormitator maculatus	Fat sleeper
Aquatic	Fish	Eleotris pisonis	Spinycheek sleeper
Aquatic	Fish	Gobiomorus dormitor	Bigmouth sleeper
Aquatic	Invertebrate	Macrobrachium carcinus	Bigclaw river shrimp
Aquatic	Invertebrate	Macrobrachium crenulatum	Crenulated river shrimp
Bird	Bird	Falco peregrinus	Peregrine falcon
Bird	Bird	Icterus portoricensis	Puerto Rican oriole
Mammal	Bat	Stenoderma rufum	Red-fig eating bat
Mollusc	Snail	Luquillia luquillensis	Luquillo mountain land snail
Reptile	Lizard	Anolis cuvieri	Puerto Rican giant anole
Reptile	Lizard	Anolis occultus	Dwarf anole

Species were then screened for inclusion in the framework and designated as species of conservation concern. The planning team used a species and Ecological Sustainability Evaluation framework for the analysis of species diversity and ecological sustainability and integrity built around principles developed by The Nature Conservancy in their Conservation Action Planning Workbook (The Nature Conservancy 2005).

Many of the species of conservation concern are also considered to be at-risk species by the USFWS; many have been petitioned to be listed under the Endangered Species Act. In Puerto Rico, large publicly owned landscapes such as El Yunque support some of the best habitat and highest densities of at-risk species in the commonwealth.

The 2012 Forest Planning Rule requires that species of conservation concern be, “known to occur in the plan area” and that the regional forester identify the species of conservation concern for which “the best available scientific information indicates substantial concern about the species’ capability to persist over the long term in the plan area.” The 2012 Forest Planning Rule recognizes that there are limits to the

agency's authority and the inherent capability of the land in providing for species. In contrast, the 1982 Forest Planning Rule required management prescriptions to, "provide for adequate fish and wildlife habitat to maintain viable populations for all existing species." The management emphasis on species of conservation concern is more focused than the viability provision under the 1982 Rule. If the responsible official determines that it is beyond the authority or not within the inherent capability of the plan area to maintain or restore ecological conditions to maintain viability of a species of conservation concern in the plan area, then the responsible official shall:

1. Document the basis for that determination;

2. Include plan components, including standards and guidelines, to maintain or restore ecological conditions within the plan area to contribute to maintaining a viable population of the species within its range.

See section 3.4.3.6 for the botanical species of conservation concern.

3.4.3.4 Terrestrial and Aquatic Species Covered by Ecosystem Components (coarse/fine-filter)

For the purposes of this analysis, the planning team used species groups, as needed, as an evaluation tool to improve planning efficiency and for development of management strategies.

Species were grouped according to ecosystem group or habitat needs, limiting factors, threats or specific habitat elements. No federally listed threatened and endangered species are included due to their specific analysis of all alternatives. Those known as species of conservation concern were included in species groups in this section because their habitats are connected to ecosystem group maintenance and restoration, and ecological sustainability. Each group was analyzed by species group and determinations made on whether species needs were fully met by plan components, considering locations for species and management area direction associated with their known populations. A description of affected environment and direct, indirect, and cumulative effects of plan alternatives on species groups and weights for general species' groups and the biological requirements associated with habitats is given below. The following species groups can be linked to general plan direction associated with the maintenance and restoration of the following forest type groups, or other plan components.

The rationale to assigning conservation status ranking is similar to the NatureServe's framework and core methodology. El Yunque's biologists mimicked the Global, National, and State ranks with the collected information by focusing on extinction risk on the global scale, and their extirpation risk at national and subnational level. Thus, much of the information found in the International Union of Conservation of Nature (IUCN) and the State Natural Heritage Plan (Puerto Rico Wildlife Conservation Strategy) are used to populate these three ranks.

Table 3-22. Species group and associated ecological/vegetation system groups from the ecological sustainability evaluation tool

Species Group
Freshwater Crustaceans
Riparian Associates
Mature *Tabebuia/Eugenia* Woodland Associates
Palo Colorado Associates
Tabonuco Associates

The ecological sustainability evaluation (ESE) tool uses a range of 0 to 10, where a score of 0 to 2.5 is designated as poor or less sustainable. A score of 2.6 to 5.0 is fair, and 5.1 to 10.00 is good or more sustainable. For more detailed information about the ESE tool please see appendix B and refer to the planning record.

Table 3-23. Group weight and description

Group Weight	Group Weight Description
Very High	All or nearly all of the species' requirements are met by the species group.
High	A high proportion of the species' requirements are met by the species group.
Moderate	A moderate proportion of the species' requirements are met by the species group.
Low	A low proportion of the species' requirements are met by the species group.

Direct and Indirect Effects Common to All Alternatives

In general, allowing natural recovery or intentional hand/mechanical treatments would be the primary management activities used to maintain and improve desired habitat conditions for at-risk species in all three alternatives. However, the extent of these treatments and the resulting quality and amount of habitat vary across the alternatives. Portions of the Forest have been heavily impacted by past naturally occurring events (e.g., hurricanes, landslides, and flooding), most recently by the pass of hurricanes Irma and María on September 2017; the ecological services should be restored to improve habitat for at-risk species that have been or continue to be impacted by these perturbations. A history of recreational use occurs in the interior and dispersed spots throughout the Forest. The planning components programmatically give parameters to this activity and adapt the intent of reducing the over-use of recreation infrastructure in the interior with a collaborative approach on the periphery of the Forest.

Cumulative Effects Common to All Alternatives

Public lands play a critical role in the conservation of rare species and native habitats, which sometimes receive little formal protection or conservation on private lands. During the next 10 to 50 years of Forest Plan implementation, human populations are likely to either expand or shift to urban areas; this will affect present urbanization, roads, and associated traffic. These trends suggest that both public and other lands will play an increasingly important role in conserving species of conservation concern in the future.

For some species of conservation concern, the Forest Service works beyond the plan area boundary and collaborates with USFWS, states, other partners, and landowners, to support an "all-lands" approach to species of conservation concern awareness. The agency has worked and continues to work with partners to reintroduce at-risk species into historical habitat on National Forest System lands where appropriate.

Forest planning components, current and new, emphasize degrees of restoration, resilience, and sustainability. Restoration in its broadest sense is about protecting, restoring, and transforming not only ecosystems, but also human systems (socioeconomic) toward resilience. Resilience is about sustainability—ecological, economic and social—under the pressures of changing atmospheric, demographic, social and political climates.

Climate change presents new challenges for managing resources. The interaction of climate change and other environmental pressures, has resulted in increased threats from fire, new insect and plant interactions, disease, extreme weather, and drought. Scientists predict that increases in temperature and changes in rainfall patterns may result in these events becoming more frequent, with more intensity and/or for longer durations.

Species Groups: Freshwater Crustaceans and Rio Mameyes Associates

Table 3-24. Freshwater crustaceans

Species Group	Scientific Name	Common Name	Designation	Group Weight
Invertebrate	Macrobrachium carcinus	Bigclaw river shrimp	SCC	Very High
Invertebrate	Macrobrachium crenulatum	Crenulated river shrimp	SCC	Very High

Table 3-25. Rio Mameyes associates

Species Group	Scientific Name	Common Name	Designation	Group Weight
Fish	Anguilla rostrata	Freshwater eel	SCC	Very High
Fish	Awaous banana	River goby	SCC	Very High
Fish	Dormitor maculatus	Fat sleeper	SCC	Very High
Fish	Eleotris pisonis	Spinycheek sleeper	SCC	Very High
Fish	Gobiomorus dormitor	Bigmouth sleeper	SCC	Very High

Alternative 1

This alternative retains all protective standards and guidelines for the waterways of El Yunque in the current Forest Plan. These standards and guidelines address water quality through best management practices.

According to the ecological sustainability evaluation tool results, the Rio Mameyes scores fair (4.84 out of 10.0) for the next 10 and 50 years under alternative 1. These results suggest that components such as water quality and quantity should be appropriate for a functioning aquatic-dependent ecosystem. In the long term (50 years), however, it may be further affected by other long-term management challenges, such as climate change and increasing human use. Thus, there is a strong notion that this alternative, although prescriptive for ecological benefits, may be limited in relation to unseen future scenarios.

Alternative 2 and 3

Specific riparian and watershed area desired conditions found in both alternatives would provide aquatic habitat protection and high water quality.

Plan components (standards and guidelines) are designed to maintain and improve habitat for species in this group. Both alternatives provide emphasis on ecologically/economical sustainable conditions to ensure management goals. The four management areas that are "preservative" in nature—MA-7 Baño del Oro expanded Research Natural Area, MA-5 El Toro Wilderness Area, MA-6 Research Area, and the MA-8 Wild/Scenic/Recreation River Corridors—provide resilience for change to both habitats and ecological functions. Management areas that allow for various degrees of use include MA-3 Communication and Recreation and MA-4 Community Interface Resource Management Area.

Cumulative Effects

The results of the ecological sustainability evaluation tool suggest that the condition of the Rio Mameyes is likely to be fair (4.84 out of 10.0) for the next 10 years and good (6.25 out of 10) for the next 50 years

under Alternatives 2 and 3. Collaboration with partners can potentially minimize cumulative effects by addressing long-term challenges that may occur outside of the planning unit, such as adjacent municipal management and other unforeseen natural resource uses.

Aquatic fauna population are expected to remain stable with effects to individuals. However, if monitoring shows otherwise, El Yunque will implement policy through better public understanding of sustainable stewardship.

The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population and the stress this creates on the natural resources. Cumulatively, environmental consequences from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall, the cumulative effects of all management actions over time are not expected to adversely affect the Rio Mameyes.

Species Groups: Mature Tabebuia/Eugenia (Elfin) Woodland Associates

Table 3-26. Mature *Tabebuia/Eugenia* (Elfin) woodland associates

Species Group	Scientific Name	Common Name	Designation	Group Weight
Amphibian	Eleutherodactylus eneidae	Mottled coqui	SCC	High
Amphibian	Eleutherodactylus gryllus	Cricket coqui	SCC	High
Amphibian	Eleutherodactylus portoricensis	Puerto Rican coqui or upland coqui	SCC	Moderate
Amphibian	Eleutherodactylus richmondi	Richmond's coqui	SCC	Moderate
Amphibian	Eleutherodactylus unicolor	Burrow coqui	SCC	High
Snail	Luquilia luquillensis	Luquillo Mountain land snail	SCC	Very High

Alternative 1

In alternative 1, mature *Tabebuia/Eugenia* woodland forest type associate habitat would continue to be maintained and enhanced as it has since the 1997 Forest Plan was written.

The results of the ecological sustainability evaluation tool suggest that the condition of the montane wet cloud forest is likely to be good (6.38 out of 10.0) for the next 10 and 50 years under alternative 1. The interpretation of these results is that components such as vegetation structure, composition, and function, should be adequate in sustaining this habitat type for use by the species. In the long term (50 years), it may be more difficult dealing with other management challenges, such as climate change, new fauna species and diseases, and human population use.

Alternative 2 and 3

Alternatives 2 and 3 propose the dispersion of recreational use from the interior of El Yunque to its periphery, thus lowering impacts from human activity to these species. If recreational areas in this habitat would be proposed, the wildlife policy would be to keep recreational impacts low relative to the functions of this forest type. Using these alternatives, individuals of the species may be impacted, but the species as a whole should remain viable.

The results of the ecological sustainability evaluation tool suggest that montane wet cloud forest is likely to be good (6.38 out of 10.0) for the next 10 years and (5.73 out of 10) 50 years under alternatives 2 and 3. Habitat components such as vegetation structure, composition, and function should be adequate in sustaining this habitat type for use by the species. Species population should remain stable, but monitoring and research may detect the long-term changes. Also in the long term (50 years), it may be more difficult dealing with other management challenges, such as climate change, new fauna species and diseases, and human population use.

Cumulative Effects

The sources of cumulative effects may occur from road and trail maintenance, rereation and fluctuating human population and the stress this creates on the natural resources. Cumulatively, environmental consequences to the montane wet cloud forest from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation and monitoring. Most adverse impacts would be low to moderate. Overall, the cumulative effects of all management actions over time are not expected to adversely affect montane wet cloud forest.

Species Groups: Palo Colorado Associates and Tabonuco Associates

Table 3-27. Palo Colorado associates

Species Group	Scientific Name	Common Name	Designation	Group Weight
Amphibian	*Eleutherodactylus hedricki*	Hedrick's coqui	Species of Conservation Concern	Moderate
Amphibian	*Eleutherodactylus karlschmidti*	Web-footed coqui	Species of Conservation Concern	Moderate
Amphibian	*Eleutherodactylus wightmanae*	Melodius coqui	Species of Conservation Concern	High

Table 3-28. Tabonuco associates

Species Group	Scientific Name	Common Name	Designation	Group Weight
Mammal	*Stenoderma rufun*	Red fig-eating bat	Species of Conservation Concern	High
Bird	*Icterus portoricensis*	Puerto Rican oriole	Species of Conservation Concern	Moderate
Bird	*Falco peregrinus*	Peregrine falcon	Species of Conservation Concern	Moderate
Amphibian	*Eleutherodactylus brittoni*	Grass coqui	Species of Conservation Concern	Moderate
Amphibian	*Eleutherodactylus locustus*	Grass coqui	Species of Conservation Concern	Moderate
Reptile	*Anolis cuvieri*	Puerto Rican giant anole	Species of Conservation Concern	Moderate
Reptile	*Anolis occultus*	Dwarf anole	Species of Conservation Concern	Moderate

Alternative 1

In alternative 1, mature Palo Colorado and Tabonuco forest type associate habitat would continue to be maintained and enhanced as it has since the 1997 Forest Plan was written.

The results of the ecological sustainability evaluation tool suggest that Palo Colorado montane rain cloud forest is likely to be good (7.08 out of 10.0) for the next 10 years and good (6.38 out of 10) for the next 50 years under alternative 1. Hence, components such as vegetation structure, composition, and function should be adequate in sustaining this habitat type for use by the associated species. Species population should remain stable, but monitoring and research may detect changes over the long term. Also, in the long term (50 years) it may be more difficult dealing with other challenges, such as climate change, invasive speices introductions, diseases, and human population use.

Alternative 2 and 3

The ecological sustainability evaluation tool results suggest that implementing alternatives 2 and 3 for the mature Palo Colorado montane rain cloud forest is likely to be in good condition (6.56 out of 10.0) for the next 10 years and good (6.39 out of 10) for the next 50 years.

Cumulative Effects

The sources of cumulative effects may occur from road and trail maintenance, recreation and fluctuating human population and the stress this creates on the natural resources. Cumulatively, environmental consequences to Palo Colorado associates and Tabonuco associates from past, present, and foreseeable actions would be minimized through the use of best management practices, proper mitigation measures, careful planning, design, implementation, monitoring and cooporative agreements with municipal and private intities. Most adverse impacts would be low to moderate. Overall, the cumulative effects of all management actions over time are not expected to adversely affect Palo Colorado associates and Tabonuco associates.

3.4.3.5 Affected Environment and Environmental Consequences – Threatened and Endangered Species (Flora)

The Forest has a total of 830 flora species; of those, 636 were evaluated to determine which should categorized as federally listed species and species of conservation concern. This evaluation resulted in 8 federally listed species and 39 species of conservation concern.

Table 3-29. List of federally listed threatened and endangered species (flora) on El Yunque

Common Name	Scientific Name
Capá Rosa	*Callicarpa ampla*
Uvillo	*Eugenia haematocarpa*
Palo de Jazmín	*Styrax portoricensis*
Palo Colorado	*Ternstroemia luquillensis*
Chupacallos	*Pleodendron macranthum*
None	*Lepanthes eltoroensis*
None	*Ilex sintenisii*
None	*Ternstroemia subsessilis*

Throughout El Yunque, threatened and endangered species protection and habitat enhancement is a priority, so their needs are particularly emphasized. The overall affected environment can be summarized as a tropical rainforest within the Caribbean Basin located between North American and South America. The vegetation on El Yunque is consistent with tropical wet rain forests and is arranged into 15 new vegetation types (See Section 3.4.3.1).

Forest plan components, such as desired conditions, standards, guidelines and objectives, provide broad management direction. These Forest Plan components comply with the requirements of the Endangered Species Act of 1973 (ESA) and the associated recovery plan for each federally listed species.

Project-level analysis will evaluate site-specific impacts, based on conditions on-the-ground. Additional mitigation measures may be developed, if needed.

In general, all federally listed threatened and endangered species would continue to be managed and protected across the Forest in accordance with Forest Service policy, recommended protection measures in the recovery plans, and all applicable state and Federal laws. Individual projects during the next planning period may result in direct negative effects to an individual, but effects analysis and consultation will take place at the project level should this situation ever occur.

As was discussed earlier, the ecological sustainability evaluation (ESE) tool is a strategic conservation planning tool used by the Forest Service Southern Region for Forest planning. Ecological systems, watersheds, and terrestrial and aquatic species are carried through the preliminary assessment and sustainability framework (including strategies and plan alternatives) to determine expected outcomes. The tool utilizes a standardized process while being flexible, efficient, and adaptable to Forest-specific priorities and needs. The ESE tool employs prioritization algorithms utilizing rank, importance rating, attributes and indicators, stresses and threats, scope and severity ratings, and management opportunities to assist and support management decisions while creating a standardized, credible, and defensible process record. The ESE tool analysis also considered the short term (1 to 10 years) and the long term (1 to 50 years) scenarios in the Forest.

Capá rosa (Callicarpa ampla): Endangered

Callicarpa ampla (Verbenaceae) is an evergreen shrub with simple, opposite leaves. It is only found in Puerto Rico at El Yunque National Forest in the Tabonuco type forest. The species is only found on El Yunque National Forest in the municipalities of Rio Grande and Naguabo in three different populations (two natural and one planted), for a total of 18 known individuals. All known *Callicarpa* sites are located in protected lands. Because of the distance between the populations, genetic material is not expected to be exchanged, except for the one in El Portal which contains genetic material (clones) from both natural populations.

See the 2014 Forest Plan Assessment section on “Assessing Ecological Sustainability and Diversity of Plant and Animal Communities (Terrestrial Ecosystems)” for a detailed description of forest types. See also the 2014 Forest Plan Assessment section on “Assessing Threatened, Endangered, Proposed and Candidate Species and Species of Conservation Concern (At-Risk Flora)” for a detailed description of this species.

Alternative 1

This alternative has several management areas that allow activities that may have direct effects on this species. These include timber demonstration, research areas, integrated areas and developed recreation areas, and all have a potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands. Diversity and forest cover is also expected to be directly impacted by the implementation of

activities on these lands. These management actions could cause a high risk of losing populations of the species reported to be very rare and small in number. Hurricanes Irma and Maria greatly affected the habitat of this species and may have affected its population. The planted population is doing well and assessments are needed to evaluate the status of the other individuals. The NEPA process is expected to occur before any particular project is implemented. Hence, direct impacts would be mitigated if properly carried out; this alternative would have management practices for the conservation and recovery of the species that could also assist is protection.

Indirect effect to this species are associated with erosion created by soil movement, tree felling and extraction, and trampling created by human activities in these management areas.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate of vegetation impacted, and continuous human activities on these lands.

Alternative 2

This alternative has the CIRMA that proposes activities that may have direct impact to this species. There are also activities proposed like improving recreation settings and access, improving roads and trails, improving watersheds, and provide forest products. All these actions incorporate vegetation management at some level in their implementation. There is a high risk of losing populations of the species reported to be very rare and small in number, if they are located in a management areas such as the CIRMA. Also, the recent impacts of hurricanes Irma and Maria have affected its habitat, increasing the risk of this endangered species. Although the NEPA process is expected to occur before any particular project is implemented. This alternative has management practices for the conservation and recovery of the species, as well as management strategies that would assist in its protection.

Beneficial effects to the populations of this species will occur because of the protection by standards and guidelines; and designated areas like wilderness, expanded research natural area, wild and scenic rivers corridors, mature forests, wetlands, and riparian zones.

Also, standards and guidelines associated with management of invasive species and climate change will benefit the persistence and/or recovery of these species in El Yunque's ecosystems.

Potential indirect beneficial effects associated with alternative 2 to these species are related to the focus of this alternative on ecological, social, and economic sustainability. This means that management practices and strategies considering sustainability will create a beneficial indirect effect on the species by sustaining the population in all activities.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices and management strategies that protect the species in El Yunque lands and its surroundings.

Alternative 3

There would be a reduction in protected areas (research natural area), but standards and guidelines for mature forest will protect the lands excluded. Increased management of invasive species and invasive species at identified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats may have direct effects on these species.

Potential beneficial effects may occur from management of the road and trail system to maintenance levels; this would reduce impacts on the species due to human interaction in certain areas where the

species is located. The exclusion of the scenic byway management area would diminish the vegetation management effects at the Forest level. The Forest will have fewer activities on the corridor, which would result in fewer management actions that could affect the species in this particular area of the Forest.

Cumulative Effects

The cumulative effects for this alternative are the same as described in alternative 2.

Uvillo (Eugenia haematocarpa): Endangered

Eugenia haematocarpa (Myrtaceae) is an evergreen tree that can reach 6 meters (20 feet). Its distribution is the Sierra de Luquillo in El Yunque National Forest and the Sierra de Cayey. Known habitat is secondary montane and mature Tabonuco montane forest types, which grow on volcanic substrate.

During the 2011 botanical survey, two populations were located at El Yunque National Forest, one in Rio Grande in El Verde area with 27 individuals and one in Rio Gurabo with 12 individuals. When Uvillo was listed as an endangered species in 1998, 119 individuals were reported within six populations; however, these other populations were not evaluated during the 2011 survey.

See the 2014 Forest Plan Assessment "At-Risk Flora" section for a detailed description of this species.

Alternative 1

This alternative has several management areas that may allow activities that could have direct effects on this species. Timber demonstration, research areas, integrated areas and developed recreation areas all have a potential to directly disturb the vegetation, soil, streams and associated fauna, in these lands. Diversity and forest cover is also expected to be directly impacted by the implementation of projects on these lands, where projects, such as further developing recreational sites or timber demo practices, are conducted where the species is located. These management areas and practices resulting from this alternative could result in a high risk of losing populations of the species that is very rare and small in number. Hurricanes Irma and Maria affected the habitat of this species, which adds to the threats to the populations. Surveys to determine the current status of this species will be performed. The NEPA process is expected to occur before any particular project is implemented. This alternative would have management practices for the conservation and recovery of the species that could also assist is protection.

Potential indirect effects to this species are associated with erosion created by soil movement, tree felling and extraction, and trampling created by human activities in these management areas.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate of vegetation impacted, and continuous human activities on these lands.

Alternative 2

Known habitat is secondary montane forest and mature Tabonuco montane forest types. See the "Terrestrial Ecosystems" section for a detailed description of these forest types. See "At-Risk Flora," for a detail description of this species.

This alternative has the CIRMA that proposes activities that may have direct impact to this species. These activities may include improving recreation settings and access, improving roads and trails, improving watersheds, and providing forest products. All these actions incorporate vegetation management at some level in their implementation, and there is a high risk of losing populations of the species that are very rare and small in number. Although the NEPA process is expected to occur before any particular project is implemented, this alternative has management practices and strategies (such as collaboration and

environmental education) for the conservation and recovery of the species, as well as management strategies that would assist in its protection.

Potential beneficial effects to the populations of this species will be through protection by standards and guidelines and protected designated areas such as wilderness, expanded research natural area, wild and scenic river corridors, mature forests, wetlands, and riparian zones.

Also, standards and guidelines associated with management of invasive species and climate change will benefit the persistence and/or recovery of these species in El Yunque's ecosystems.

Potential indirect beneficial effects associated with alternative 2 to these species are related to the focus of this alternative on ecological, social, and economic sustainability. This means that management practices and strategies considering sustainability will create a beneficial indirect effect on the species.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices and management strategies that persist and protect the species at El Yunque lands and its surroundings.

Alternative 3

Known habitat is secondary montane forest and mature Tabonuco montane forest types. See the "Terrestrial Ecosystems" section for a detail description of these forest types. See "At-Risk Flora" for a detailed description of this species.

There would be a reduction in the number of acres of the research natural area and the reduced area will be proposed as wilderness, standards and guidelines for mature forest will protect the lands excluded. Increase of invasive species and invasive species management at identified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats may have direct effects on these species.

Beneficial effects may occur from management of the road and trail system to maintenance levels, because of impacts on the species due to human interaction in certain areas. Excluding the Scenic Byway Management Area will reduce the vegetation management effects at the Forest level. The Forest will have fewer activities in the corridor resulting in fewer management actions that could affect the species.

Cumulative Effects

The cumulative effects for this alternative is the same as described in alternative 2.

Guayabota pequeña (Ilex sintenisii): Endangered

Ilex sintenissi (Aquifoliaceae) is a shrub/small tree with alternate leaves. Its distribution is limited to El Yunque National Forest, specifically to Pico El Yunque and Pico del Este. These areas are located in the cloud forest type, which grow above 600m in elevation on volcanic substrate. As of 2011, there were approximately 465 individuals on 23 populations, an increase from the 150-200 individuals in three populations identified during the 1995 recovery plan.

Known habitat is mature *Tabebuia/Eugenia* woodland montane rain cloud forest type. See the 2014 Forest Plan Assessment "Terrestrial Ecosystems" section for a detailed description of this vegetation type. See the 2014 Forest Plan Assessment "At-Risk Flora" section for a detailed description of this species.

Alternative 1

This alternative recommends the no more development or expansion of communication facilities on El Yunque Peak and Pico del Este. These management recommendations markedly reduce the potential of direct impact to the species. El Yunque Peak is impacted by a high number of visitations to its featured points (El Yunque Trail, El Yunque Rock, and El Yunque and Mt. Britton Towers).

A potential effect on Ilex may be caused under this alternative because recreational development and the increased number of Forest visitors to the area that could trample on the species. The human activity in this area may impact vegetation by trampling, generating trash, and vigilance and maintenance on the various communication sites at Pico El Yunque and recreation points (Mt. Britton Tower).

Cumulative Effects

The most critical cumulative effects to this species and its natural habitat is the accumulation of small spills of oil, gasoline, diesel and fumes as part of the operation of the communication sites and ground maintenance, as well as the maintenance of the access roads and recreation points through time. The high humidity and high rate of precipitation in this unique forest type increases the impact to the environment over time.

Alternative 2

Effects are similar to alternative 1, while considering in this alternative the options of dispersing recreation to other areas in CIRMA could potentially reduce the amount of impact on the species in certain locations.

Cumulative Effects

A cumulative effect to this species is related to past projects that have impacted the species through habitat loss by projects such as the communication facilities and infrastructure development in these sites.

Alternative 3

Known habitat is the mature *Tabebuia/Eugenia* woodland montane rain cloud forest type. (Pico El Yunque and Pico de El Este). See the 2014 Forest Plan Assessment "Terrestrial Ecosystems" section for a detailed description of this vegetation type. See the 2014 Forest Plan Assessment "At-Risk Flora" section for a detailed description of this species.

The effects are the same as described for alternative 2.

Lepanthes eltoroensis: Endangered

Lepanthes eltoroensis (Orchidaceae) is a small epiphytic orchid. It grows on the north-face (non-windy) side of moss covered trunks on upper elevations (above 750 meters) in the Sierra Palm, Palo Colorado and mature *Tabebuia/Eugenia* woodland montane wet cloud forest types. The population was estimated at 360 individuals at the time of listing and recent estimates based on surveys and expert opinions indicate a range of 3,000 individuals.

See the 2014 Forest Plan Assessment "At-Risk Flora" section for a detailed description of this species. This vegetation type is located inside El Toro Wilderness.

Alternative 1

Effects of this alternative to the species is visitation to the area. The trail where the species thrives is the only official access to the wilderness, and because most of the populations of this species are known to

occur along the trail, the species is highly exposed to damage by trampling activities and also on some occasion to unauthorized collection of this very rare and endangered orchid.

Beneficial direct effects are associated with the designation of its habitat as part of El Toro wilderness. Under this designation, the management practices are limited, and therefore this could result in less population loss of the species.

Potential for indirect effects most damaging to this species, such as trampling and unauthorized collections, are related to visitation of the area.

Cumulative Effects

Visitation activities over time may have cumulative detrimental effects to the species.

Alternative 2

Beneficial direct effects are associated with the designation of its habitat as part of El Toro Wilderness. Under this designation the management practices and strategies (such as collaboration and environmental education) limit impacts and human interaction with the species which could result in less population loss.

The potential for indirect effects is the same as described in alternative 1.

Cumulative Effects

The cumulative effects for this alternative are similar to alternative 1. However, the increase of environmental literacy component and the revision of wilderness management directions of this alternative may reduce effects of visitation and human dynamics. As management direction for the wilderness area is developed, the amount of visitation and type of uses should consider minimal impacts to the species.

Alternative 3

Known habitat is mature *Tabebuia/Eugenia* woodland montane wet cloud forest. See the 2014 Forest Plan Assessment "Terrestrial Ecosystems" section for a detailed description of this vegetation type. This vegetation type is located inside El Toro Wilderness. The effects are the same as described for alternative 2.

Direct, indirect, and cumulative effects are the same as alternative 1.

Chupacallos (Pleodendron macranthum): Endangered

Pleodendron macranthum (Canellaceae) is an evergreen tree, for which there are 2 known populations with 11 individuals at El Yunque National Forest; however none of these individuals were located during the 2011 botanical survey. There are 25 planted individuals, 3 at El Portal Visitor Center and 22 at the Puerto Rican Parrot Aviary. Known habitat is secondary montane and mature Tabonuco montane forest types. See the 2014 Forest Plan Assessment "At-Risk Flora" section for a detailed description of this species.

Alternative 1

This alternative has several management areas that would allow activities that may have direct effects on this species. Management areas for timber demonstration, research areas, integrated area and developed recreation areas all have a potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands. These management areas and practices resulting from this alternative could result in a high risk of losing populations of the species that are very rare and small in number. Also, the effects of recent

hurricanes have increased the risk of these populations. Although the NEPA process expected to occur before any particular project is implemented should mitigate direct impacts if properly carried out, this alternative would have management practices for the conservation and recovery of the species that would also assist in its protection.

Potential indirect effects to this species are associated with erosion created by soil movement, tree felling and extraction, and trampling created by human activities in these management areas.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems and recovery rate along time of vegetation impacted.

Alternative 2

This alternative has the CIRMA that proposes activities that may have direct impact to this species. These may include improving recreation settings and access, improving roads and trails, improving watersheds, and providing forest products. All these actions incorporate vegetation management at some level in their implementation. In addition, direct impact to this species in the passing of hurricanes Irma and Maria that may have impacted *Pleodendron* populations; assessments will continue to determine its impacts. There is a high risk of losing populations of the species that are very rare and small in number. Although the NEPA process is expected to occur before any particular project is implemented, this alternative has management practices and strategies (such as collaboration and environmental education) for the conservation and recovery of the species, as well as management strategies that would assist in its protection.

Potential beneficial effects to the populations of this species will be associated with the protection by guidelines, standards, and protected designated areas like wilderness, expanded research natural area, wild and scenic river corridors, mature forests, wetlands and riparian zones.

Also, standards and guidelines associated with management of invasive species and climate change will benefit the persistence and/or recovery of these species in El Yunque's ecosystems.

Indirect beneficial effects associated with alternative 2 to this species are related to the focus of this alternative to ecological, social, and economic sustainability. This means that management practices and strategies considering sustainability will create a beneficial indirect effect on the species.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices and management strategies that persist and protect the species on El Yunque and its surroundings.

Alternative 3

The effects are the same as described for alternative 2.

Palo de Jazmín (Styrax portoricensis): Endangered

Styrax portoricensis (Styracaceae) is an evergreen tree for which its known habitat is secondary montane, mature Tabonuco montane and mature Palo Colorado montane wet cloud forest types. There were 19 reported individuals at El Yunque National Forest, however during the last botanical survey, none of these populations were recorded. About 50 individuals were planted by FWS around the Puerto Rican Parrot Aviary.

See the 2014 Forest Plan Assessment "At-Risk Flora" section for a detailed description of this species.

Alternative 1

This alternative has several management areas that would allow activities that may have direct effects on this species. Management areas such as timber demonstration, research areas, integrated area and developed recreation areas all have a potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands, through the management practices and activities. Diversity and forest cover is also expected to be directly impacted by the implementation of projects on these lands such as further developing recreational sites or timber demo practices. These management areas and practices resulting from this alternative could result in a high risk of losing populations of the species that are very rare and small in number. In addition, hurricanes Irma and Maria may have impacted the habitat of *Styrax*; surveys are being performed to determine the current status of the populations. Although the NEPA process expected to occur before any particular project is implemented, this alternative would have management practices for the conservation and recovery of the species that could also assist in its protection. Part of the population of this species is reported to be inside El Toro Wilderness area, which is expected to be fully protected, but because the small population sizes (sometimes consisting of one or two individuals) are in isolated areas of the wilderness, the lack of monitoring to determine population conditions puts this species at high risk.

Potential indirect effect to this species are associated with erosion created by soil movement, tree felling and extraction, and trampling created by human activities in the management areas outside the wilderness.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate over time of vegetation impacted, and continuous human activities over time on the lands outside the wilderness.

Alternative 2

This alternative has the CIRMA that proposes activities that may have direct impact to this species. These may include improving recreation settings and access, improving roads and trails, improving watersheds, and providing forest products. All these actions incorporate vegetation management at some level in their implementation. In addition, hurricanes Irma and Maria may have impacted the habitat of *Styrax*; surveys are being performed to determine the current status of the populations. There is a high risk of losing populations of the species that are very rare and small in number, if they are located in management areas such as the CIRMA. Although the NEPA process is expected to occur before any particular project is implemented, this alternative has management practices and strategies (such as collaboration and environmental education) for the conservation and recovery of the species, as well as management strategies that would assist in its protection.

Standards and guidelines and protected designated areas such as wilderness, expanded research natural area, wild and scenic river corridors, mature forests, wetlands, and riparian zones, would have beneficial direct effects to the populations of this species.

Also, standards and guidelines associated with management of invasive species and climate change will benefit the persistence and/or recovery of these species in El Yunque's ecosystems.

Indirect beneficial effects associated with alternative 2 to this species are related to the focus of this alternative to ecological, social and economic sustainability. This means that management practices and strategies considering sustainability will create a beneficial indirect effect on the species due to trying to sustain the population in all activities.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices and management strategies that persist and protect the species at El Yunque lands and its surroundings.

Alternative 3

The effects are the same as described for alternative 2.

Palo Colorado (Ternstroemia luquillensis): Endangered

Ternstroemia luquillensis (Pentaphylacaceae) is an evergreen tree that can reach 20 meters. Its population is limited to 6 known individuals from 4 populations within the mature Palo Colorado montane, mature Tabonuco and montane cloud forest types, although two individuals may have been misidentified.

See the 2014 Forest Plan Assessment "Terrestrial Ecosystems" section for a detailed description of these vegetation types. See the 2014 Forest Plan Assessment "At-Risk Flora" section for a detailed description of this species.

Alternative 1

This alternative has several management areas that allow activities that may have direct effects on this species. Management areas such as timber demonstration, research areas, integrated area and developed recreation areas all have a potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands. Diversity and forest cover is also expected to be directly impacted by the implementation of projects on these lands, where projects such as further developing recreational sites or timber demo practices where the species is located. These management areas and practices resulting from this alternative could result in a high risk of losing populations of the species that are very rare and small in number. In addition, hurricanes Irma and Maria may have impacted the habitat of *Ternstroemia luquillensis*; surveys will be performed to determine the current status of the populations. Although the NEPA process is expected to occur before any particular project is implemented and should mitigate direct impacts, if properly carried out, this alternative has management practices for the conservation and recovery of the species that could also assist is protection.

Part of the population of this species is reported to be inside El Toro Wilderness area, the research natural area, wild and scenic river corridors and El Yunque Peak, which is expected to be fully protected. However, because of the small population sizes mostly consisting of one or two individuals in isolated areas of designated areas, lack of monitoring to determine population conditions puts this species at high risk.

Potential indirect effect to this species are associated with erosion created by soil movement, tree felling and extraction, and trampling created by human activities in the management areas outside the wilderness and the research natural area and other protected areas.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate over time of vegetation impacted, and continuous human activities over time on the lands outside the wilderness and the research natural area.

Alternative 2

Although the NEPA process is expected to occur before any particular project is implemented, this alternative has management practices and strategies (such as collaboration and environmental education)

for the conservation and recovery of the species, as well as management strategies that would assist in its protection. There is a high risk of losing populations of the species that are very rare and small in number, due to various reasons including the lack of monitoring. Part of the population of this species is reported to be inside El Toro Wilderness area, the research natural area, wild and scenic river corridors, wetlands and El Yunque Peak, which is expected to be fully protected. However, because the small population sizes mostly consisting of one or two individuals in isolated sites of designated areas, lack of monitoring to determine population conditions puts this species at very high risk. In addition, hurricanes Irma and Maria may have impacted the habitat of *Ternstroemia luquillensis*; surveys will be performed to determine the current status of the populations. This alternative does, however, consider monitoring and collaboration that could help mitigate the effects of the population's conditions.

There are no potential indirect effects to the species with the implementation of this alternative.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices and management strategies that persist and protect the species at El Yunque lands and its surroundings.

Alternative 3

The effects are the same as described for alternative 2.

Ternstroemia subsessilis: Endangered

Ternstroemia subsessilis (Pentaphylacaceae) is an evergreen tree/shrub with alternate leaves that can grow up to 5 meters. It had approximately 37 individuals distributed among 4 populations; however during the last survey in 2011, those populations could not be found. Known habitat are mature Palo Colorado montane, mature Sierra palm montane and mature *Tabebuia/Eugenia* woodland montane rain cloud forest types.

See the 2014 Forest Plan Assessment "Terrestrial Ecosystems" section for a detailed description of this vegetation type. See the 2014 Forest Plan Assessment "At-Risk Flora" section for a detailed description of this species.

Alternative 1

This alternative has several management areas that may have direct effects on this species. These include timber demonstration, research areas, wild and scenic rivers, and developed recreation areas; all of which have the potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands. In addition, hurricanes Irma and Maria may have impacted the habitat of *Ternstroemia subsessilis*; surveys will be performed to determine the current status of the populations. Although the NEPA process is expected to occur before any particular project is implemented, this alternative has management practices and strategies (such as collaboration and environmental education) for the conservation and recovery of the species, as well as management strategies that would assist in its protection. These management areas and practices resulting from this alternative could result in a high risk of losing populations of the species that are very rare and small in number. Part of the population of this species is reported to be inside the research natural area, wild and scenic river corridors, the wetlands and Pico del Este, which is expected to be fully protected. However, because the small population sizes mostly consisting of one or two individuals in isolated areas of designated areas, lack of monitoring to determine population conditions puts this species at very high risk. This alternative does, however, consider monitoring and collaboration that could help mitigate the effects of the population's conditions.

Indirect effects to this species are associated with erosion created by soil movement, tree felling and extraction, and trampling created by human activities in the management areas outside the wilderness and the research natural area.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate over time of vegetation impacted, and continuous human activities over time on the lands outside the wilderness and the research natural area and other protected lands.

Alternative 2

Although the NEPA process is expected to occur before any particular project is, this alternative has management practices and strategies (such as collaboration and environmental education) for the conservation and recovery of the species, as well as management strategies that would assist in its protection. There is a high risk of losing populations of the species that are very rare and small in number, due to various reasons including the lack of monitoring. Part of the population of this species is reported to be inside El Toro Wilderness area, the research natural area, wild and scenic river corridors, wetlands, and El Yunque Peak, which is expected to be fully protected. However, because the small population sizes mostly consisting of one or two individuals in isolated sites of designated areas, lack of monitoring to determine population conditions puts this species at very high risk.

No indirect effects are expected to occur with the implementation of this alternative.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices and management strategies that persist and protect the species at El Yunque lands and its surroundings.

Alternative 3

The effects are the same as described for alternative 2.

3.4.3.6 Affected Environment and Environmental Consequences – Species of Conservation Concern (Flora)

Using the best available scientific information, species known to occur in the plan area for which there is substantial concern about the species' capability to persist over the long term in the plan area were evaluated. We assume that populations of all the species of conservation concern are stable until we can gather data to quantify and locate the populations in existence on El Yunque. This assumption is based on the lack of forest-disturbing activities in the Forest, but we will consider climate change in the analysis. To be classified as "at risk," a species must have an Extent of Occurrence (EOO) of <20,000 square kilometers, the threshold for IUCN's threatened categories. Puerto Rico measures 8,870 square kilometers, therefore all endemic species (229) are technically considered "at risk" (Krupnick et al. 2012; Miller and Lugo 2009).

A brief description of the ecology and distribution for the species of conservation concern for El Yunque and the environmental effects of the alternatives proposed for the land management plan revision follows.

Orchids

Of the 149 orchid species reported to Puerto Rico, 45 percent are reported as being native to the Luquillo Mountains (Kasomenakis 1988). Seven endemic species and one native are considered at-risk species and have been proposed for further analysis as species of conservation concern for El Yunque National Forest

(table 3-30). These are small plants that range in size from several millimeters to 14 centimeters tall. They are epiphytic plants found in a variety of environments, from mossy boulders along streams to moss covered tree trunks and branches in wet mountain and wet mountain cloud forest and on sphagnum moss on the peaks forest floor. Two of them *Brachionidium ciliolatum* and *Lepanthes selenitepala* are endemic to the Luquillo Mountains. Some are also present in the Sierra de Cayey and the Cordillera Central (on State Forests), but there is an overall lack of information on the population locations and sizes. The altitudinal ranges go from 215 meters to 1,300 meters above sea level.

They are mostly threatened by vegetation management affecting forest canopy, road and trail right of way maintenance, hurricane winds, landslides, low population numbers and some unauthorized collecting.

Hurricanes are a major threat to orchids, since their small sizes and restricted population ranges make them vulnerable to the strong winds which could tear them from their host and/or knock the host tree to the ground.

Climate change that affects the humidity required for the different forest types where they thrive may impair the moss layers in the different forest compartments where they are present, directly impacting their survival, reproduction, and population sizes.

3.4.3.7 Affected Environment and Environmental Consequences – Species of Conservation Concern (Flora)

Using the best available scientific information, species known to occur in the plan area for which there is substantial concern about the species' capability to persist over the long term in the plan area were evaluated. We assume that populations of all the species of conservation concern are stable until we can gather data to quantify and locate the populations in existence on El Yunque. This assumption is based on the lack of forest-disturbing activities in the Forest, but we will consider climate change in the analysis. To be classified as "at risk," a species must have an Extent of Occurrence (EOO) of <20,000 square kilometers, the threshold for IUCN's threatened categories. Puerto Rico measures 8,870 square kilometers, therefore all endemic species (229) are technically considered "at risk" (Krupnick et al. 2012; Miller and Lugo 2009).

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Table 3-30. Species of conservation concern (flora)

Taxonomic Group	Taxonomic Subgroup	Species	Common Name
Vascular Plant	Fern	*Lindsaea stricta var. jamesoniformis*	Lindsaea
Vascular Plant	Herb	*Pilea multicaulis*	P. Multicaulis
Vascular Plant	Herb	*Pilea yunquensis*	P. Yunquensis (endemic)
Vascular Plant	Orchid	*Brachionidium ciliolatum*	B. Ciliolatum
Vascular Plant	Orchid	*Brachionidium parvum*	B. Parvum
Vascular Plant	Orchid	*Lepanthes caritensis*	Carite babyfoot orchid
Vascular Plant	Orchid	*Lepanthes dodiana*	Dodiana babyfoot orchid
Vascular Plant	Orchid	*Lepanthes selenitepala spp ackermanii*	Ackerman babyfoot orchid
Vascular Plant	Orchid	*Lepanthes stimsonii*	Stimson babyfoot orchid
Vascular Plant	Orchid	*Lepanthes veleziana*	Velez babyfoot orchid
Vascular Plant	Orchid	*Lepanthes woodburyana*	Woodbury babyfoot orchid
Vascular Plant	Shrub	*Brunfelsia lactea*	Jazmin de monte (endemic)
Vascular Plant	Shrub	*Brunfelsia portoricensis*	Jazmin portoricensis (endemic)
Vascular Plant	Shrub	*Marlierea sintenisii*	Beruquillo
Vascular Plant	Shrub	*Miconia foveolata*	Camasey
Vascular Plant	Shrub	*Solanum woodbury*	Solanum (endemic)
Vascular Plant	Shrub	*Urera chorocalpa*	Ortiga (endemic)
Vascular Plant	Shrub	*Varronia wagnerorum*	Varronia (endemic)
Vascular Plant	Shrub/Small tree	*Cybianthus sintenisii*	Cybianthus (endemic)
Vascular Plant	Shrub/Small tree	*Eugenia egersii*	Palo de murta (endemic)
Vascular Plant	Shrub/Small tree	*Xylosma schwaneckeana*	Palo de Candela (endemic)
Vascular Plant	Small tree	*Miconia pycnoneura*	Camasey
Vascular Plant	Tree	*Ardisia luquillensis*	Mamayuelo (endemic)
Vascular Plant	Tree	*Banara portoricensis*	Caracolillo (endemic)
Vascular Plant	Tree	*Calyptranthes luquillensis*	C. Luquillensis (endemic)
Vascular Plant	Tree	*Calyptranthes woodburyi*	C. Woodburyi (endemic)
Vascular Plant	Tree	*Coccoloba rugosa*	Ortegon
Vascular Plant	Tree	*Conostegia hotteana*	Camasey peludo
Vascular Plant	Tree	*Laplacea portoricensis*	Maricao verde
Vascular Plant	Tree	*Magnolia splendens*	Laurel sabino (endemic)
Vascular Plant	Tree	*Maytenus elongata*	Cuero de Sapo
Vascular Plant	Tree	*Morella holdrigeana*	Palo de cera (endemic)
Vascular Plant	Tree	*Psidium sintenisii*	Hoja menuda (endemic)
Vascular Plant	Tree	*Ravenia urbanii*	Tortugo prieto (endemic)

Taxonomic Group	Taxonomic Subgroup	Species	Common Name
Vascular Plant	Tree	*Symplocos lanata*	Nispero cimarron (endemic)
Vascular Plant	Tree	*Ternstroemia heptasepala*	Palo colorado (endemic)
Vascular Plant	Tree	*Ternstroemia stahlii*	Palo de buey (endemic)
Vascular Plant	Vine	*Gonocalix portoricensis*	Gonocalyx (endemic)
Vascular Plant	Vine	*Mikania pachyphyla*	Mikania (endemic)

This alternative has several management areas that may have direct effects on these species. These include timber demonstration, research areas, integrated area and developed recreation areas, and all have a potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands. Diversity and forest cover is also expected to be directly impacted by the implementation of projects on these lands, such as projects which further develop recreational sites or timber demo practices where the species is located. These management areas and practices resulting from this alternative could result in a high risk of losing populations of the species that are very rare and small in number. In addition, hurricanes Irma and Maria may have impacted the habitat of these species. The NEPA process is expected to occur before any particular project is implemented. This alternative would also have management practices for the conservation and recovery of the species that could assist in its protection.

Standards and guidelines and protected designated areas such as wilderness, expanded research natural area, wild and scenic river corridors, mature forests, wetlands, and riparian zones, would have beneficial direct effects to the populations of this species.

Indirect effects to these species are associated with the erosion created by soil movement, tree felling and extraction, and trampling created by human activities in these management areas.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate over time of vegetation impacted, and continuous human activities over time on these lands. The proximity of some of the proposed activities to each other is critical to this type of effects.

Alternative 2

This alternative has the CIRMA that proposes activities that may have direct impact to these species. These may include improving recreation settings and access, improving roads and trails, improving watersheds, and providing forest products. All these actions incorporate vegetation management at some level in their implementation. There is a high risk of losing populations of the species that are reported to be very rare and small in number. Although the NEPA process is expected to occur before any particular project is implemented and should mitigate direct impacts, this alternative also has management practices and strategies (such as collaboration and environmental education) for the conservation and recovery of the species, as well as management strategies that would assist in its protection.

Beneficial direct effects to many of the populations of these orchids will be associated with the protection provided by guidelines, standards and protected designated areas like wilderness, expanded research natural area, wild and scenic rivers, mature forests, wetlands and riparian zones.

In addition, standards and guidelines associated with management of invasive species and climate change will benefit the persistence and/or recovery of these species in El Yunque ecosystems.

Indirect beneficial effects associated with alternative 2 to these species are related to the focus of this alternative on ecological, social, and economic sustainability. This means that management practices and strategies considering sustainability will create a beneficial indirect effect on the species.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices and management strategies that persist and protect the species on El Yunque National Forest lands and its surroundings.

Alternative 3

There will be a reduction in protected area as research natural area, but standards and guidelines for mature forest will protect the lands excluded. Increased management of invasive species and Invasive species at identified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats may have direct effects on these species.

Beneficial effects may occur from management of the road and trail system maintenance levels, considering it would reduce the impacts on the species from human interaction in certain areas where the species is located. The exclusion of the Scenic Byway Management Area will reduce the effects of vegetation management at the Forest level. The Forest will have fewer activities in the corridor, resulting in less management actions that could affect the species in this particular area of the Forest.

Cumulative Effects

The cumulative effects are the same as described in alternative 2.

Vines

There are two vines proposed as species of conservation concern, one (*Gonocalix portoricensis*) is endemic to El Yunque and restricted to the peaks, and the other is endemic to Puerto Rico (*Mikania pachyphyla*) (table 3-30). The latter is present also in the Cordillera Central; its population is estimated at 2,946 individuals, but the population in El Yunque has not being determined or mapped. *G. portoricensis* population is being estimated to be eight individuals.

They are mostly threatened by vegetation management affecting forest canopy, road and trail right-of-way maintenance, hurricane winds, low population numbers, and landslides.

Climate change that affects the humidity required for the different forest types where they thrive may impair its persistence at El Yunque.

Alternative 1

These species are not expected to be directly affected by this alternative, given the fact that they are reported in areas designated for protection, such as wetlands, mature palm forests and cloud rain forest types.

These species are not expected to be indirectly affected by this alternative.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices that persist and protect the species in El Yunque lands and its surroundings.

Alternative 2

These species are not expected to be directly affected by this alternative, given the fact that they are reported in areas designated for protection, like wetlands, mature palm forests and cloud rain forest types.

These species are not expected to be indirectly affected by this alternative.

Cumulative Effects

The cumulative effect of this alternative will be associated with long-term benefits of management practices and management strategies that persist and protect the species in El Yunque lands and its surroundings.

Alternative 3

There will be a reduction in the protected research natural area, but standards and guidelines for mature forest will protect the lands excluded. Increased management of invasive species at identified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats may have direct effects on these species.

Beneficial effects may occur from management of the road and trail system maintenance levels, considering it would reduce the impacts on the species due to human interaction in certain areas where the species is located. The exclusion of the Scenic Byway Management Area will reduce the vegetation management effects at the Forest level. The Forest will have fewer activities on the corridor, resulting in fewer management actions that could affect the species in this particular area of the Forest.

Cumulative Effects

The cumulative effects are the same as described for alternative 2.

Shrubs

There are 11 endemic shrub species recommended as species of conservation concern on El Yunque, of which 4 are endemic to the Luquillo Mountains (*Marlierea sintenisii*, *Miconea faveolata*, *Varronia wagnerorum*, and *Solanum woodbury*). There are seven plant families represented in this group (table 3-30).

All of these species are reported or estimated to have small populations, making the species vulnerable to any disturbance that may change the vegetation structure of the Forest, its geomorphology, or its landform morphology.

The principal immediate threat to all these species on El Yunque is the lack of information about their population numbers and location so that we can monitor the effects of stresses such as climate change, hurricane winds, landslides and canopy (structure) changes. Shrubs are part of the ground cover vegetation strata and are a key element in the food web of the Forest.

Hurricanes are particulary a major threat and considering the lack of information on their current population status, then analyzing the effects is difficult. Hurricanes Irma and Maria, which recently passed over El Yunque on September 2017, likely further affected these populations.

Alternative 1

This alternative has several management areas that may have direct effects on these species. These include timber demonstration, research areas, integrated area and developed recreation areas, and all have the potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands. Diversity and forest cover are also expected to be directly impacted by the implementation of projects on these

lands, where projects such as further developing recreational sites or timber demo practices are implemented where the species is located. These management areas and practices resulting from this alternative could result in a high risk of losing populations of the species that are very rare and small in number. In addition, hurricanes Irma and Maria may have impacted the habitat of these species. The NEPA process expected to occur before any particular project is implemented. In addition, this alternative would have management practices for the conservation and recovery of the species that would help protect it.

Standards and guidelines and protected designated areas such as wilderness, expanded research natural area, wild and scenic river corridors, mature forests, wetlands, and riparian zones, would have beneficial direct effects to the populations of this species.

Indirect effect to this species are associated with erosion caused by soil movement, tree felling and extraction, and trampling created by human activities in these management areas.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate over time of vegetation impacted, and continuous human activities over time on these lands. The proximity of some of the proposed projects to each other is critical to these effects.

Alternative 2

This alternative has the CIRMA that proposes activities that may have direct impact to these species. Proposed activities such as improving recreation settings and access, improving roads and trails, improving watersheds, and providing forest products are expected to have direct effects these species. All these actions incorporate vegetation management at some level in their implementation. There is a high risk of losing populations of the species that are very rare and small in number, if they are located in a management area such as the CIRMA. In addition, hurricanes Irma and Maria may have impacted the habitat of these species. Although the NEPA process is expected to occur before any particular project is implemented and should mitigate direct impacts, this alternative has management practices and strategies (such as collaboration and environmental education) for the conservation and recovery of the species, as well as management strategies that would assist in its protection.

Beneficial direct effects to many of the populations of these shrubs will be associated with the protection provided by guidelines, standards and protected designated areas like wilderness, expanded research natural area, wild and scenic rivers corridors, mature forests, wetlands and riparian zones.

In addition, standards and guidelines associated with management of invasive species and climate change will benefit the persistence and/or recovery of these species in El Yunque's ecosystems.

Indirect effects associated with the proposed activities of alternative 2 to these species are soil erosion, soil compaction, vegetation trampling, and vegetation density reduction mostly associated with providing recreation and forest products, although this alternative includes activities such as collaboration, environmental education and other management strategies that could mitigate these indirect effects.

Cumulative Effects

The cumulative effect in this alternative will be associated with the intensity and proximity of the activities implementation. Direct and indirect effects may be compounded if proximity of projects to each other is not considered.

Alternative 3

There will be a reduction in the protected research natural area, but standards and guidelines for mature forest will protect the lands excluded. Increased management of invasive species and Invasive species at identified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats El Yunque lands may have direct effects on these species.

Beneficial effects may occur from management of the road and trail system maintenance levels, considering it would reduce the impacts on the species due to human interaction in certain areas where the species is located. The exclusion of the Scenic Byway Management Area will reduce the vegetation management effects at the Forest level. The Forest will have fewer activities on the corridor, resulting in fewer management actions that could affect the species in this particular area of the Forest.

Cumulative Effects

The cumulative effects are the same as described for alternative 2.

Trees

There are 15 species in this group recommended for species of conservation concern; 8 endemic, 4 native, and 3 endemic to El Yunque (*Magnolia splendens*, *Calyptrantes luquillensis* and *Ternstroemia heptasep*ala) (table 3-30). They represent 12 plant families. All of the species listed (except the *Magnolia*) thrive under the dominant canopy of the Forest (they are small trees, 50 feet at the tallest). All of them are reported or estimated to have small populations making them vulnerable to any disturbance that may change the vegetation structure of the Forest, its geomorphology, or its landform morphology.

The principal immediate threat to all these species in El Yunque is the lack of information about their population numbers and location so that we can monitor the effects of stresses or disturbances as climate change, hurricane winds, landslides and canopy (structure) changes. This is also true for all species of conservation concern.

Magnolia splendens – Laurel Sabino (G3)

This species is endemic to the Luquillo Mountains and the only known populations are inside El Yunque. It is native to an area where tree growth is slow, 0.06 inches diameter increase in a period of 5 years from a sample of 46 trees. Most seeds apparently are sterile; this fact greatly limits the future of this tree. Young trees are being encouraged wherever they appear naturally; its range is between 400 to 850 meters of elevation above sea level. This means that part of the population is expected to be inside the cloud forest (functional wetland). During the 1930s the use of mature trees for furniture and cabinet making by the Civilian Conservation Corps dramatically reduced the mature population of this species (Little and Wadsworth 1964).

The Department of the Environment and Natural Resources of the Commonwealth of Puerto Rico classifies the species as a “critical element” based on its classification code. It is a species to be monitored to determine its actual present range, population sizes and locations, phenology, and reproduction efforts.

Alternative 1

This alternative has several management areas that may have direct effects on these species. These include timber demonstration, research areas, integrated area and developed recreation areas, and all have the potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands. Diversity and forest cover are also expected to be directly impacted by the implementation of projects on these lands, where projects such as further developing recreational sites or timber demo practices occur where the species is located. These management areas and practices resulting from this alternative could result in

a high risk of losing populations of the species that are very rare and small in number. In addition, hurricanes Irma and Maria may have impacted the habitat of this species. The NEPA process expected to occur before any particular project is implemented; however, this alternative would have management practices for the conservation and recovery of the species that would also protect it.

Many of the populations of these trees will be protected by guidelines, standards, and protected designated areas like wilderness, research natural area, wetlands, and mature forests.

Potential indirect effect to these species are associated with erosion created by soil movement, tree felling and extraction, and trampling created by human activities in these management areas.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate over time of vegetation impacted, and continuous human activities over time on these lands. The proximity of some of the proposed projects to each other is critical to this type of effects.

Alternative 2

This alternative has the CIRMA that proposes activities that may have direct impacts on these species. Proposed activities such as improving recreation settings and access, improving roads and trails, improving watersheds, and providing forest products, are expected to have direct effects on this species. All these actions incorporate vegetation management at some level in their implementation. There is a high risk of losing populations of the species that are very rare and small in number if they are located in a management area such as the CIRMA. In addition, hurricanes Irma and Maria may have impacted the habitat of this species. The NEPA process expected to occur before any particular project is implemented; however, this alternative has management practices and strategies (such as collaboration and environmental education) for the conservation and recovery of the species, as well as management strategies that would assist in its protection.

Beneficial direct effects to the populations of these trees will be associated with the protection from guidelines, standards, and protected designated areas like wilderness, expanded research natural area, wild and scenic river corridors, mature forests, wetlands, and riparian zones.

In addition, standards and guidelines associated with management of invasive species and climate change will benefit the persistence and/or recovery of these species in El Yunque's ecosystems.

Potential indirect effects to this species associated with the activities of alternative 2 would allow soil erosion, soil compaction, and vegetation trampling and vegetation density reduction mostly associated with providing recreation and forest products, although this alternative includes activities such as collaboration, environmental education and other management strategies that could mitigate these indirect effects.

Cumulative Effects

The cumulative effect in this alternative will be associated with the intensity and proximity of the activities implementation. Direct and indirect effects may be compound if proximity of projects to each other is not considered.

Alternative 3

There will be a reduction in the protected research natural area, but standards and guidelines for mature forest will protect the lands excluded. Increased management of invasive species at identified sites like

road right-of-ways, recreation areas, and threatened or endangered species habitats may have direct effects on these species.

Beneficial effects may occur from management of the road and trail system maintenance levels; this would reduce the impacts on the species due to human interaction in certain areas where the species is located. The exclusion of the Scenic Byway Management Area will reduce the vegetation management effects at the Forest level. The Forest will have fewer activities on the corridor, resulting in fewer management actions that could affect the species in this particular area of the Forest.

Cumulative Effects

The cumulative effects are the same as described for alternative 2.

Ferns and Herbs

There are three species in this group, one endemic to El Yunque (*Pilea multicaulis*), and three endemic to Puerto Rico (table 3-30). Three species are reported to range between 650 and 1,300 meters of elevation above sea level in the cloud forest (functional wetland). The population in El Yunque still needs to be assessed. *Lindsaea stricta* var. *jamesoniiformis* is the only fern in this group.

All of these species are reported or estimated to have small population that renders the species vulnerable to any disturbance that may change the vegetation structure of the Forest, its geomorphology, or its landform morphology.

The principal immediate threat to all these species at El Yunque is the lack of information about their population numbers and location to be able to monitor the effects of stresses or disturbances as climate change, hurricane winds, landslides and canopy changes.

Alternative 1

This alternative has several management areas that may have direct effects on these species. These include timber demonstration, research areas, integrated area and developed recreation areas, and all have the potential to directly disturb the vegetation, soil, streams, and associated fauna in these lands. Diversity and forest cover are also expected to be directly impacted by the implementation of projects on these lands, where projects such as further developing recreational sites or timber demo practices occur where the species is located. These management areas and practices resulting from this alternative could result in a high risk of losing populations of the species that are very rare and small in number. In addition, hurricanes Irma and Maria may have impacted the habitat of these species. The NEPA process expected to occur before any particular project is implemented should mitigate direct impacts; however, this alternative would have management practices for the conservation and recovery of the species that could also help protect them.

Many of the populations of these ferns and herbs will be protected by guidelines, standards, and protected designated areas like wilderness, research natural areas, wild and scenic river corridors and mature forests.

Potential indirect effects to this species are associated to erosion created by soil movement, tree felling and extraction, and trampling created by human activities in these management areas.

Cumulative Effects

Cumulative effects are associated with long-term erosion problems, recovery rate over time of vegetation impacted, and continuous human activities over time on these lands. The proximity of some of the proposed projects to each other is critical to these types of effects.

Alternative 2

Increased management of invasive species on all El Yunque lands may have direct positive effects on these species by potentially creating more habitat for these ferns and herbs.

Potential indirect effects associated with the proposed activities of alternative 2 to these species are soil erosion, soil compaction, vegetation trampling and vegetation density reduction mostly associated with providing recreation and forest products; although this alternative proposes activities such as collaboration, environmental education and other management strategies that could mitigate these indirect effects.

Cumulative Effects

The cumulative effects in this alternative will be associated with the intensity and proximity of the activities implementation. Direct and indirect effects may be compounded if proximity of projects to each other is not considered.

Alternative 3

Increased management of invasive species at identified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats may have direct positive effects on these species by potentially creating more habitat for these ferns and herbs.

Beneficial effects may occur from management of road and trail system maintenance levels, considering it would reduce the impacts on the species due to human interaction in certain areas where the species is located. The exclusion of the scenic byway management area will reduce the vegetation management effects at the Forest level. The Forest will have fewer activities on the corridor and therefore result in fewer management actions that could affect the species in this particular area of the Forest.

Cumulative Effects

The cumulative effects are the same as described for alternative 2.

3.4.4 Forest Health

Functioning ecological systems that support the diversity of native plants and animals depend on healthy forests to warrant the physical and biotic resources to support these systems. Most of the ecosystems dominated by native species are resistant or resilient to dramatic change caused by abiotic and biotic stressors. Through an adaptive management approach, priorities for management activities can be modified to respond to changing conditions that could affect the functioning ecological systems of the Forest. In El Yunque, the forest types area associated with the elevation and amount of rain they receive, creating conditions to the define areas of the Forest as wetland and other, as with a mosaic of vegetation species because of previous management practices and disturbances that dominate the lower elevations of the Forest.

3.4.4.1 Affected Environment: Terrestrial Ecosystems–Vegetation

The Plan established the preservation of mature forests and the conservation, maintenance, and restoration primarily with native species. The secondary montane wet forest and secondary submontane moist forest will be evaluated in relation to the ecological vegetation composition and ecological functions to monitor its resistance or resiliency to dramatic change caused by abiotic and biotic stressors.

3.4.4.2 Environmental Consequences: Terrestrial Ecosystems–Vegetation

Alternative 1

This alternative maintains the management conditions of the 1997 Plan in which the re-construction of trails was considered in areas of mature forests. A demonstration project of sustainable timber production was also considered as part of the management strategies for alternative 1. The timber demonstration area considers the removal of up to one-third of the overstory trees. The alternative also considers the application of selective cuttings to benefit trees with greater potential for future growth and value. For alternative 1, the expected direct and indirect effects are minimal because of the standard and guidelines considered for the restoration of the trails and because the timber demonstration project include no mature forest and only represents a small part of the Forest (1,167 acres). No alterations of the vegetation diversity are expected from the management applications.

Alternative 2 and 3

These alternatives include the vision of retaining a healthy, accessible, and sustainable forest that integrates multiple uses; provides economic, ecological, and social opportunities; promotes education, environmental justice, cultural and environmental identity, and awareness for the conservation of its natural resources; and for adaptive forest management that is inclusive and collaborative. The alternatives also identify geographic areas for El Yunque Region. This approach benefits the evaluation of the terrestrial ecosystem in relation to the vegetation because the geographic areas permit the development of specific desired conditions, objectives, goals, and other plan components conducive to effective planning and management that fit the sub-regional context.

For alternative 2 the region is divided in three geographic areas providing a watershed management component to the geographic areas that integrate the municipalities of Ceiba and Fajardo. The application of this third geographic area provides an important recognition to the water resources of El Yunque and deals with an integrated watershed management approach that could be applied according to the watershed classification framework. Both alternatives consider the CIRMA that merges segments of the Forest that were considered for timber demonstration, developed recreation and integrated management in the 1997 Plan. This consolidation of lands under one management area provide sections of the Forest where an assortment of resource management practices could be applied to encourage tropical forest management initiatives in the broader landscape of El Yunque. The CIRMA management area is at the lower elevation areas of the Forest and it includes areas where plantations for potential timber projects were established in previous management plans. The absence of timber stand improvements in plantations and the impact of natural disturbances have created a mosaic of vegetation in these areas where introduced species, like the mahogany, share the forest composition with native species. The stand dynamic of these forests is different from other mature forests within El Yunque and the succession that these forest stands that follow will create a combination of species that tropical ecologists have identified as an “emerging forest.” The adaptation and naturalization of invasive species in these areas added with climate changes and the tension created by external land uses in the periphery of the Forest present conditions that require a special outlook to the forests that compose the CIRMA. The standards and guidelines considered for this management area will diminish any direct or indirect effects.

Cumulative Effects

The alternatives 2 and 3 include the geographic area approaches that provide regional perspective of the vegetation management. These alternatives could represent positive effects for the vegetation of the region as private lands are considered and observed as part of the regional management approach. The Community Interface Resource Management Area (CIRMA) provides opportunities for forest product utilization strategies that are applied in other tropical forests that can be coordinated with community

groups and residents. The application of agroforestry initiatives such as analog forestry, a form of agroforestry that maintains a tree-dominated ecosystem while providing marketable products (IAFN 2012), could represent restoration initiatives with potential economic revenues. The demonstration and application of these practices could be reproduced in other areas promoting the extension of the forest coverage in the region.

3.4.4.3 Affected Environment: Insects and Diseases

This section examines the potential threats to forest health and those that might require active prevention, suppression, or monitoring efforts, as well as strategies in each of the three alternatives for achieving healthy forests.

Alternative 1 maintains a timber demonstration area that used a reduced area of the Forest for the silvicultural practices associated for the project. Alternatives 2 and 3 do not consider a timber demonstration project, but include the CIRMA located at the lower elevation areas of the Forest and adjacent areas where plantations for potential timber projects were established in previous management plans. In this management area, an assortment of resource management practices could be applied to encourage tropical forest management initiatives in the broader landscape of El Yunque.

The considered actions and standards and guidelines defined for the CIRMA are expected to improve the native species diversity and the resilience of the area to potential stressors such as diseases, insect outbreaks and responses to natural disturbances. Some of the specifications for this area include:

- Maintain trees and vegetation on the stream bank except at designated crossings or for ecological or stream restoration.
- Conduct enrichment planting strategies in the riparian zone with native species.
- Retain stumps, standing snags, den trees, and coarse woody debris. Exceptions may be made where necessary to control insects or disease outbreaks or to provide public and employee safety.
- Forest products projects should maintain forest canopy coverage of the area. If a natural disturbance occurs, prevent further canopy openings and downed timber should be identified for salvage.

The rapid growth rate of some tropical trees species, as well as the fact that the growth is continuous over much of the year, allow trees to outgrow the attack from most leaf-feeding insects (Hodges and McFadden 1987). Insects also have beneficial roles in the Forest such as the process of pollination and seed dispersal. Some birds and fishes rely on insects for their nutrition. Drewry (1970) published a list of 1,200 insects collected at El Verde and were deposited in the collection at El Verde Field Station.

The literature did not account for major harmful effects from insects in El Yunque National Forest. Studies for some species like *Heliconia caribaea* (Richardson and Hull 2000) and in Bromeliads (Richardson 1999) show a high diversity of ecosystems at different scales of the Forest that are important to the insect fauna of the Forest.

The Forest Service conducts communication efforts and participates in interagency groups that focus on monitoring and identification of insect outbreaks in Puerto Rico. The USDA Animal and Plant Health Inspection Service (APHIS), the Department of Agriculture of Puerto Rico, the Department of Natural and Environmental Resources, the Agricultural Experimental Station of the University of Puerto Rico, the U.S. Fish and Wildlife Service and the Forest Service integrate a working group for the reported cases of *Hypogeococcus pungens*; an insect, native to South America, that attacks the cactus of the Island. Similar approaches were done for the pink hibiscus mealybug (*Maconellicoccus hirsutus*) that attacks more than 200 plant species, including agricultural value species. This bug has been controlled with biological controls and no major problems have been reported in the Forest from this insect. The red palm mite

(*Raoiella indica* Hirst), a pest of several important ornamental and fruit-producing palm species, has invaded the Western Hemisphere and is in the process of colonizing islands in the Caribbean, as well as other areas on the mainland. In November 2006, this pest was found in Puerto Rico, but it has not been reported in El Yunque. The *Tabebuia* trees through the Island have been observed with dramatically deformed foliage. The deformations were produced by the thrips named *Holopothrips tabebuiae* and it was reported in Puerto Rico in 2007. Within 6 months of its discovery in Puerto Rico virtually every *Tabebuia heterophylla*, commonly called the roble rosado, was infested and displaying the symptoms of crinkled leaves, deformed by the feeding thrips. Other species of *Tabebuia* are also infested, but at much lower rates. The thrips and their damage are still common, but the thrips do not appear to have impacted the populations of *Tabebuia heterophylla* in Puerto Rico.

Alternatives 1, 2, and 3

The proposed management applications for the three alternatives maintain a monitoring protocol and the collaborative initiatives with agencies that observe insect and diseases outbreaks in Puerto Rico. No direct or indirect effects are expected, and alternative 2 includes the management practices as well as the standards and guidelines to improve the native species diversity and the resilience of the area to potential stressors such as diseases, insect outbreaks and responses to natural disturbances.

Alternatives 2 and 3 include the geographic areas for El Yunque region and this perspective of the "all-lands" approach should benefit the monitoring strategies as well as the participation of organizations and interest groups that could help in the identification of changes in species conditions that could be associated with insect and diseases outbreaks.

Table 3-31. Invasive faunal species (for management responses)

Species Name	Status	Threats posed	Management Responses
Mongoose *Herpestes auropunctatus*	Occurs throughout El Yunque National Forest, concentrates at recreation areas	Disease vector, potential aggressive human interactions, predation on Federally-listed species.	Live trapping for removal
Black rats *Rattus rattus*	Occurs throughout El Yunque National Forest	Disease vector, potential aggressive human interactions, predation on Federally-listed species.	Live trapping for removal and use of rodenticides
Feral dog *Canis familiarus*	Occurs on man-made transportation systems and recreation areas	Disease vector, potential aggressive human interactions	Live trapping for removal
Feral cats *Felis catus*	Occurs on man-made transportation systems and recreation areas	Disease vector, potential aggressive human interactions	Live trapping for removal
Iguana *Iguana iguana*	Occurs at random locations throughout El Yunque National Forest	potential aggressive human interactions	Live trapping for removal
House mouse *Mus musculus*	Occurs throughout El Yunque National Forest	Disease vector	Live trapping for removal

3.4.4.4 Affected Environment: Invasive Fauna and Diseases

Terrestrial species such as mongoose (*Herpestes auropunctatus*), black rats (*Rattus rattus*), feral dogs (*Canis familiarus*) cats (*Felis catus*) the iguana (*Iguana iguana)* and the house mouse *(Mus musculus)* are

reported in the 2014 Forest Plan Assessment. These species can affect niche availability and individual behavior of native and endemic species. Some of these species are associated with recreational areas because of the availability of food leftovers. The wild and scenic rivers management area are maintained in all the considered alternatives and the trapping and removal of feral dogs, cats, and mongoose is considered as part of the standard and guidelines management applications. For both alternatives 2 and 3 in regard to feral dogs and cats, there will be better collaboration with municipalities to use pounds for the collection of captured individuals. All species found in table 3-31 shall not have any significant management response changes in either alternatives, except for the scale of treating the species. The most significant is alternative 2, which aims at managing throughout El Yunque National Forest. Alternative 3 is focused only at identified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats.

The chytrid fungus (*Batrachochytrium dendrobatis*) was identified in Puerto Rico since the mid-1970s (Longo et al. 2010). The fungus has affected populations of endemic coquis (tree frogs) species and scientists believe that it can be exacerbated by climate change. The considered alternatives are not expected to promote the fungus conditions in the native and endemic fauna that could be affected.

3.4.4.5 Environmental Consequences: Invasive Fauna and Diseases

Alternatives 1, 2 and 3

Alternative 1 considers the development of recreational areas that could have indirect effects in the presence of some of the invasive fauna identified as undesirable in the natural environment of the Forest. Alternatives 2 and 3 consider the use of the lower elevations and the spaces with potential use in the CIRMA to disperse recreational activities and reduce pressure in some of the current recreational areas. This action could produce some indirect effects in relation to the presence of invasive fauna species in the CIRMA, but could also produce a positive direct effect if the invasive fauna populations decrease in the higher elevation zones of the Forest.

Alternatives 2 and 3 include the geographic areas for the forest region and the participation of organizations and interest groups that could help in the control strategies and in the outreach process to reduce the behavior of visitors that could increase the populations of invasive fauna, which in turn could affect the forest environment. The effects to public health and ecological dynamics of feral dogs, cats, and mongoose are expected to be locally controlled with the trap and removal standard and guidelines applications.

3.4.4.6 Affected Environment and Environmental Consequences: Invasive Plant Species

Invasive plant species have been introduced to the Forest either accidentally (i.e. escaped ornamental) or purposefully (for agricultural or forestry purposes). Species such as bamboo were planted for erosion control along roads have spread beyond their original planted areas. The blue-green fern or the peacock fern (*Selaginella willdenowii*) was probably planted as an ornamental in the surrounding houses of the Forest. Other species have been identified in these areas that are associated with the lower elevations zones of the forest and areas with a historical land use that included agricultural activities applied before their integration as a designated National Forest. Some examples are kudzu (*Pueraria phaseoloides*) and rose apple (*Syzygium jambos*). Regardless of how they were introduced, they displace native species from their habitat and have the potential to alter forest structure and ecosystem processes.

Alternatives 1, 2 and 3

Alternative 1 includes the timber demonstration area where these areas will be managed to maintain the composition of timber species, mainly mahogany. Alternatives 2 and 3 consider the use of the lower elevations of the CIRMA to develop projects that encourage forest management initiatives that could be applied to tropical forests. The standards and guidelines considered establish specific conditions to assure the ecosystems functions and the application of practices that benefit the native species, such as:

- Conduct enrichment planting strategies in the riparian zone within the CIRMA with native species, and control high-priority plant invasive species using mechanical, hand removal, and/or other manual techniques with a monitoring protocol and replace them with native plant species.
- Do not remove trees and vegetation on the stream bank except at designated crossings or for ecological or stream restoration. Forest products projects should maintain forest canopy coverage of the areas. If a natural disturbance occurs that opens the canopy, prevent further canopy openings in a forest product project and downed timber should be identified for salvage.

3.4.4.7 Affected Environment: Invasive Aquatic Species

The aquatic ecosystems of the Forest were defined by two elements in the 2014 Forest Plan Assessment:

- Defined in relation to the type of stream and rivers that occur in the planning area, and
- Defined by the composition and structure of the aquatic faunal communities that persist in the Forest steams.

The many invasive aquatic species are generally found in modified habitats, such as in reservoirs and downstream of instream aquatic species movement barriers.

3.4.4.8 Environmental Consequences: Invasive Aquatic Species

Alternatives 1, 2 and 3

Alternative 1 does not specify management of invasive aquatic species. None of the invasive aquatic species are classified as federally listed aquatic species. In alternatives 2 and 3 standards and guidelines would provide for the maintenance of healthy native wildlife and aquatic species populations, including monitoring for changes over time.

3.5 Economic and Social Environment

3.5.1 Socioeconomics

3.5.1.1 Affected Environment

Humans have long-standing and complex ties to El Yunque. The human uses, values, interactions, and impacts associated with the Forest have shifted over time. Historically, the area now encompassed by El Yunque was a place of sacred and supernatural experience revered by the Taínos and other pre-Colombian inhabitants. Through the process of European colonization and early association with the United States, the Forest increasingly came to be seen through a utilitarian lens as a source of timber and later, charcoal, water, and recreation (Domínguez Cristóbal 1997a, 1997b; Robinson 1997). Today, people view the Forest as a place of profound ecological, social, economic, historical, and cultural importance, and associate it with a wide range of benefits and services for local communities and society at large.

It is important to understand the socioeconomic conditions and trends in and around the Forest and how they might be affected by Forest management decisions, particularly as neighboring and nearby

communities often have strong ties to public lands and are those most likely to be affected by changes in management direction and use. In this section, we provide information on the socioeconomic environment surrounding El Yunque and analyze the potential effects of the three proposed alternatives on local communities, the broader region within which it is situated, and society at large. Consistent with the 2014 Forest Plan Assessment and other planning documents, nine municipalities comprise the socioeconomic environment described in this section: Canóvanas, Ceiba, Fajardo, Juncos, Las Piedras, Luquillo, Naguabo, Humacao and Río Grande (also referred to here as El Yunque Region or the region)(map 1-1). These municipalities and the communities therein have longstanding social and economic ties to the Forest and the goods and services that it protects and provides.

Below, we describe the current conditions and trends related to the socioeconomic environment in the area surrounding El Yunque (i.e., affected environment), including population dynamics, human health and well-being, economic diversity, and other socioeconomic factors. This information provides a baseline against which the potential consequences of alternative management scenarios can be measured. Then, we describe the economic implications of plan alternatives taking into account potential changes in budget expenditures associated with management actions on the Forest, as well as potential changes in collaboration and partnerships associated with new and modified management strategies. We then discuss the social implications of management actions and strategies, focusing on communities of place (i.e., defined by geographic or political boundaries) and interest (e.g., stakeholder or interest groups). Information is analyzed at multiple levels (e.g., community, municipal, regional) to provide for a better understanding of existing and potential intraregional differences and nuances. Future projections are largely based on qualitative analysis carried out by a multi-disciplinary team of scientists and practitioners.

Table 3-32. Total area and national forest area in El Yunque Region

Municipality	Total Area (square miles)	Total Area (acres)	NF Area (square miles)	NF Area (acres)	NF Acreage (percentage)
Canóvanas	33.00	21,121	3.19	2,042	9.7
Ceiba	29.26	18,729	3.34	2,135	11.5
Fajardo	30.23	19,348	0.95	608	3.2
Humacao	44.75	28,640	0	0	0
Juncos	26.59	17,017	0.03	21	0.1
Las Piedras	33.89	21,692	1.98	1,268	5.8
Luquillo	25.79	16,503	5.62	3,599	21.6
Naguabo	51.78	33,141	8.38	5,360	16.1
Río Grande	60.85	38,943	20.26	12,969	33.2
Region	336.14	215,134	43.75	28,002	13.0
Puerto Rico	3,515	2,249,600	43.75	28,002	1.2

The nine municipalities surrounding El Yunque extend over 336 square miles (about 10 percent of Puerto Rico's total area) (table 3-32). They encompass coastline, plains, hills, and mountains within a complex matrix of land cover and use (Gould et al. 2012). El Yunque accounts for 13 percent of their total combined area. Eight municipalities have some of their land base within the boundaries of El Yunque, ranging from less than 1 percent of the total area of Juncos to more than 33 percent of Río Grande).

Humacao is the only municipality in El Yunque Region with no land falling within the national Forest boundary.

Table 3-33. Total population and population change in the municipalities in El Yunque Region and Puerto Rico, 1970–2014, select years

Area	Population (average annual change)					
	1970	1980	1990	2000	2010	2014
Canóvanas	-	31,880 (-)	36,816 (1.55%)	43,335 (1.77%)	47,648 (0.99%)	47,648 (-0.04%)
Ceiba	10,312	14,944 (4.49%)	17,145 (1.47%)	18,004 (0.50%)	13,631 (-2.43%)	12,607 (-0.75%)
Fajardo	23,032	32,087 (3.93%)	36,882 (1.49%)	40,712 (1.04%)	36,993 (-.091%)	34,049 (-0.80%)
Humacao	36,023	46,134 (2.81%)	55,203 (1.97%)	59,035 (0.69%)	58,466 (-0.10%)	57,181 (-0.55%)
Juncos	21,814	25,397 (1.64%)	30,612 (2.05%)	36,452 (1.91%)	40,290 (1.05%)	40,102 (-0.47%)
Las Piedras	18,112	22,412 (2.37%)	27,896 (2.45%)	34,485 (2.36%)	38,675 (1.22%)	38,671 (0.00%)
Luquillo	10,390	14,895 (4.34%)	18,100 (2.15%)	19,817 (0.95%)	20,068 (0.13%)	19,338 (-0.91%)
Naguabo	17,996	20,617 (1.46%)	22,620 (0.97%)	23,753 (0.50%)	26,720 (1.25%)	26,886 (0.16%)
Río Grande	22,032	34,283 (5.56%)	45,648 (3.32%)	52,362 (1.47%)	54,304 (0.37%)	52,668 (-0.75%)
Region	-	242,649 (-)	290,922 (2.00%)	327,955 (1.41%)	336,795 (0.35%)	328,959 (-0.59%)
% Puerto Rico	-	6.15%	6.69%	8.61%	9.04%	9.27%
Puerto Rico	2,712,033	3,196,520 (7.59%)	3,522,037 (8.26%)	3,808,610 (7.52%)	3,725,789 (-2.22%)	3,548,397 (-4.76%)

Source: U.S. Census Bureau, American Fact Finder 2015.

Population Trends

Information on population and other demographic conditions and trends is fundamental to sound resource management, particularly in terms of understanding and managing human-environment interactions. Nearly 330,000 people lived in the nine municipalities comprising El Yunque Region in 2014 (U.S. Census Bureau 2015) (table 3-33). Humacao had the largest population (57,181), followed by Río Grande and Canóvanas (52,668; 47,457, respectively); while Ceiba and Luquillo had the smallest populations (12,607; 19,338, respectively). The area surrounding El Yunque accommodated a growing population and an increasing percent of Puerto Rico's total population through the early 2000s. However, the total number of inhabitants in the region is estimated to have declined since about 2010, decreasing by 2.35 percent between 2010 and 2014 (-0.59 percent per year) (U.S. Census Bureau 2015) (figure 3-7). During this period, Naguabo was the only municipality in the area that continued to see an estimated increase in population (0.16 percent per year), while Las Piedras showed no measurable change in its population and the other seven municipalities saw population declines. Fajardo and Ceiba demonstrated the highest rates of population loss between 2010 and 2014 (-1.99, -1.88 percent per year, respectively). These losses continued a downward trend experienced in the two municipalities beginning in the mid-2000s, attributed in part to the closure of Roosevelt Roads Naval Base in 2004, which led to the relocation of thousands of military members and their families to other bases around the world.

Puerto Rico as a whole has seen significant changes in the size of its population since the early 2000s (i.e., 2000–2010: -0.22 percent per year; 2010–2014: -1.19 percent per year) (U.S. Census Bureau 2015), demonstrating the greatest exodus of people since the "Great Migration" of Puerto Ricans to mainland U.S. following World War II (Cohn et al. 2014). Population loss across Puerto Rico, including El Yunque Region, is projected to persist and perhaps increase with continued outmigration (e.g., 2015–2025 projected at -6.9 percent (Banco Popular de Puerto Rico 2013) and an overall decline in birth rates (e.g., 2000: 15.2, 2013: 10.1 live births per 1,000 persons) (CDC 2002, 2015)).

It is estimated that 135,000 Puerto Ricans relocated to the United States six months after Hurricane Maria landed in Puerto Rico (Hinojosa, Román, & Meléndez, 2018).

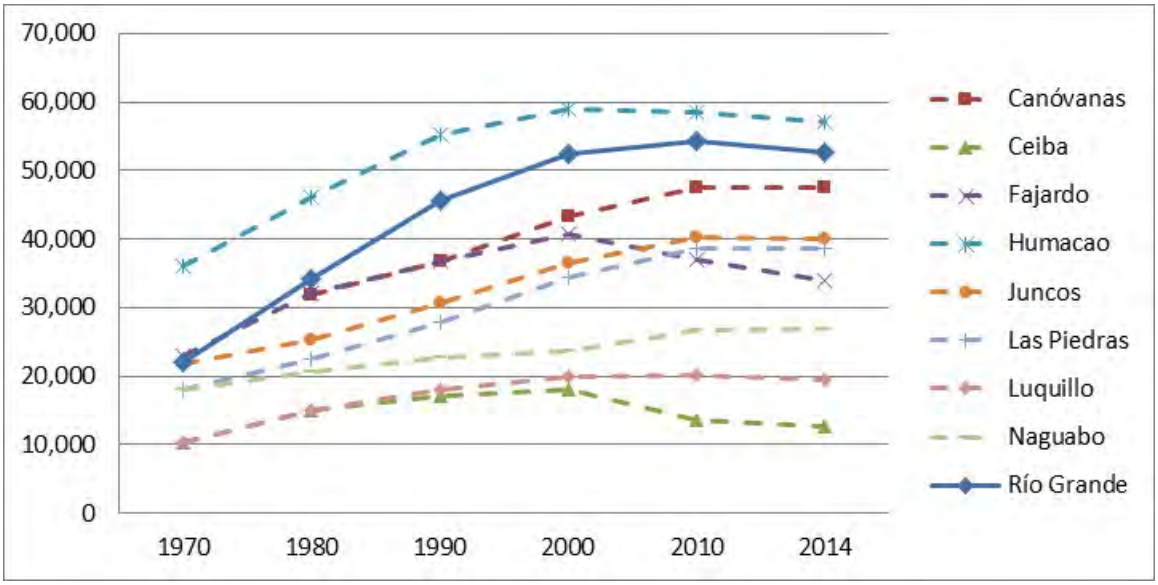


Figure 3-7. Total population in the municipalities surrounding El Yunque, 1970 to 2014

Data source: U.S. Census Bureau, American Fact Finder (2015).

Table 3-34. Population density in El Yunque Region and Puerto Rico, 1970–2014, select years

Geographic Area	Population Density persons/mi^2					
	1970	1980	1990	2000	2010	2014
Canóvanas	-	966.1	1,122.4	1,321.2	1,449.8	1,438.1
Ceiba	381.9	553.5	591.2	620.8	469.5	430.9
Fajardo	743.0	1,002.7	1,233.5	1,361.6	1,238.7	1,126.3
Humacao						1,277.8
Juncos	839.0	940.6	1,150.8	1,370.4	1,521.0	1,508.2
Las Piedras	548.8	659.2	822.9	1,017.3	1,141.5	1,141.1
Luquillo	399.6	572.9	704.3	771.1	777.5	7,49.8
Naguabo	346.1	396.5	437.5	459.4	517.2	519.2
Río Grande	361.2	553.0	752.0	862.6	895.8	865.5
El Yunque Region	-	674.6	809.2	923.1	955.4	978.64
Puerto Rico	792.3	924.4	1,027.9	1,112.0	1,088.2	1,009.5

Population Density

There were about 933 persons per square mile in El Yunque Region in 2014, which was slightly less than the population density Islandwide (1,009 persons per square mile) (U.S. Census Bureau) (table 3-34). Population densities within the region have increased since 1970, though growth peaked in the early 2000s, following the total population trend. Intra-regionally, there was considerable variation in population densities at the municipal level, ranging from 431 persons per square mile in Ceiba to 1,508 persons per square mile in Juncos. Notably, Ceiba's population density in 2010, while the lowest in the region, still ranked higher than 93 percent of all counties in the U.S. Additionally, Puerto Rico's population density in 2010 was second only to New Jersey (1,196 persons per square mile) and places Puerto Rico among the most densely populated countries in the world (UN 2013).

Urban/rural Population[2]

Population growth in the region surrounding El Yunque throughout much of the 20th Century, led to extensive expansion in housing, infrastructure, and other built-up areas, and ultimately, more than 95 percent of the population being classified as urban by the U.S. Census Bureau in 2010, ranging from 88 percent in Ceiba to 98 percent in Fajardo (table 3-35). As recently as the 1970s, more than 60 percent of the area's population was classified as rural (U.S. Census Bureau 2015). Since then, the area has steadily shifted from a rural to an urban dominated population as the density of residents and residential, commercial, and other developed areas have increased. Only Ceiba has seen a recent decline in the percent of its population that is classified as urban, which is attributable in large part to the marked decline in its total population since the early 2000s (table 3-35 and figure 3-7). Similar trends may be seen in much of the region, as people continue to leave the Island from both urban and rural areas and as population totals continue to decline. Nevertheless, given the density of housing, infrastructure, and other built up areas, and the persisting high density of inhabitants, the population surrounding El Yunque is likely to remain highly urbanized into the foreseeable future.

Urbanization can result in increased job opportunities and better health care options as compared to rural areas, but also often implies increased demands and impacts on natural resources and services (McKinney 2002). Increases in housing, infrastructure, and other built-up areas has directly impacted forest cover in the region through its removal, affecting forest processes through fragmentation of the landscape, disruption of hydrological systems, introduction of invasive species, and interruption of nutrient cycles, for example, which collectively result in changes in the benefits and services that a forest provides (Lugo et al. 2004). The impacts of urbanization are further compounded in the context of global climate change, particularly in places like Puerto Rico, where human resources and capital infrastructure to address such problems are limited. For example, as projected sea level rise leads to a loss of land and infrastructure, there is potential for inland and upland migrations of populations, resulting in more intensive and extensive urban development closer to the Forest edge (Lewsey et al. 2004; Kelman and West 2009). Indirectly, increases in population density and urbanization can lead to impoverishments in the quality of recreational and other human interactions with nature due to the loss of open spaces, natural scenery, recreational sites, and other resources (Lugo et al. 2004). And while the population in Puerto Rico in general and around El Yunque in particular, has recently begun to decrease, high rates of population density and development persist, with ongoing implications for the Forest, its management, and its interconnections with other natural or vegetated areas within the broader landscape.

[2] In the remainder of this section, data is provided for the eight municipalities directly bordering El Yunque, following the analysis conducted for the Forest Assessment. Humacao was not analyzed in the Assessment and therefore is not included in the remaining data presented here.

Table 3-35. Population classified as urban by the U.S. Census Bureau in the region surrounding El Yunque National Forest, select years 1970 to 2010

Jurisdiction	Urban Population as Percent of Total Population				
	1970	1980	1990	2000	2010
Canóvanas	*	61.3	69.1	97.3	97.7
Ceiba	28.6	60.9	78.7	92.7	88.2
Fajardo	79.2	83.9	85.8	97.8	97.9
Juncos	36.6	72.7	81.4	98.5	96.8
Las Piedras	25.6	27.0	58.6	93.1	97.6
Luquillo	0.0	30.4	47.9	93.9	91.6
Naguabo	25.7	20.1	27.6	91.1	90.6
Río Grande	31.8	56.2	55.3	95.6	97.4
Region	36.7	55.0	64.5	95.6	96.0
Puerto Rico	58.1	66.8	71.2	94.4	93.4

* Canóvanas was legally designated as a municipality in September 1970, after the decennial census was conducted. Therefore, the regional data point does not include Canóvanas in the 1970 data point.
Source: U.S. Census Bureau, American Factfinder 2015.

Age and Gender

The median age of the regional population has been increasing slowly over the past several decades, ranging from 34.3 to 37.7 years in 2014 (Naguabo, Ceiba, respectively) (U.S. Census Bureau 2015). Except for Fajardo and Ceiba, the municipalities surrounding El Yunque have slightly younger populations than the United States and Puerto Rico as a whole (i.e., 36.8, 36.9 years, respectively). The municipalities to the south of the Forest (Naguabo, Las Piedras, Juncos) had the youngest populations in the region in terms of the median age of their inhabitants, followed by the municipalities to the north (Canóvanas, Río Grande, Luquillo), and those to the east (Fajardo, Ceiba). Females represent slightly more of the regional population than males (52 versus 48 percent, respectively) (figure 3-8). When age is considered, females account for 50.5 percent and males for 49.5 percent of the population aged 44 years and less, but in the population aged 45 years and older, females account for 54.3 percent of the total.

While the population surrounding El Yunque has aged slowly but steadily in recent decades, the age structure of the regional population has changed quite dramatically in recent years (figure 3-8). Through the end of the 20th Century, the municipalities surrounding the Forest demonstrated a pyramidal age structure, which is associated with moderate population growth (i.e., proportionally more of the population is found in the younger age groups). By 2014, the age structure shifted to a more conical shape, with a smaller proportion of children (less than 18 years of age) and a greater proportion of individuals aged 40 years or more in the population. This shift is indicative of very limited to no population growth as the proportion of individuals in each age group falls within a small range of variation. Canóvanas and Fajardo saw some of the most pronounced changes in population structure during this time as the proportion of individuals in older age groups expanded and younger age groups retracted (McGinley 2016).

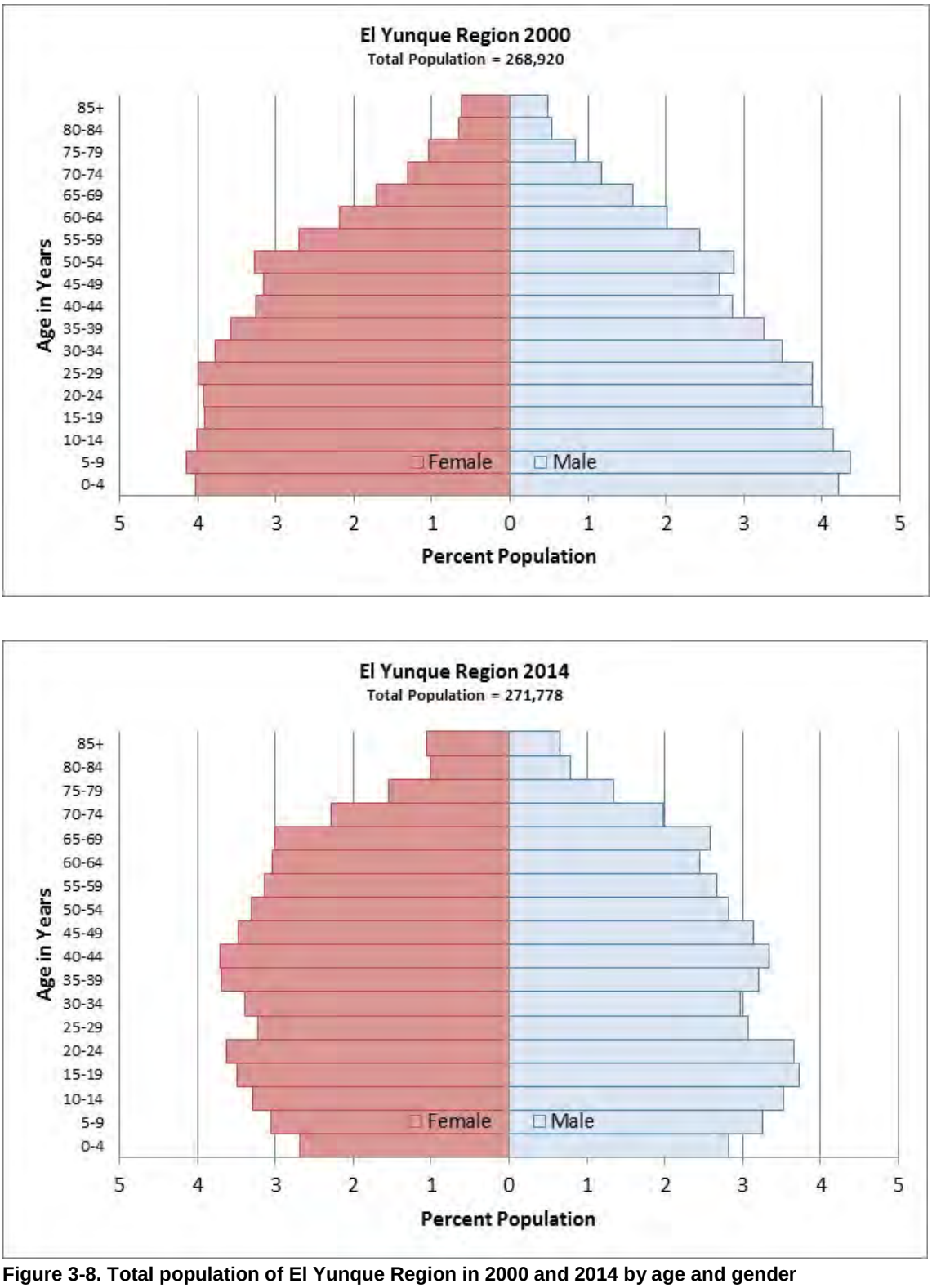


Figure 3-8. Total population of El Yunque Region in 2000 and 2014 by age and gender

Data Source: U.S. Census Bureau, American Factfinder (2015).

As the population around the Forest continues to shift in terms of number, age structure, and gender distribution, as predicted in the near term at least, changes are likely to occur in individual and community values, uses, needs, and demands on public lands. For example, in general, the emigrants

leaving Puerto Rico in recent years are younger on average than those who remain in Puerto Rico, but have similar or slightly lower levels of educational attainment as the Islandwide population (refuting reports of a perceived "brain drain" [i.e., increasing out-migration of the most educated and trained professionals] in Puerto Rico) (Birston and Meléndez 2015; Duany 2015). This leaves behind a growing segment of the population over 45 years of age. The already perceptible shifts in the region's population and age structure, which are likely to be exacerbated by increasing emigration, will bring with them changes in the needs and demands for health care, education, recreation, and other resources and amenities that directly and indirectly influence the Forest and its planning and management, including new and different opportunities for Forest use and interaction.

Education

In 2010, 69 percent of the adult population (25 years or older) in the area had finished high school (69 percent) and about 19 percent had completed a bachelor's degree or higher (19 percent) (table 3-36). Educational attainment in the region is slightly less than Islandwide rates, and lower than the mainland U.S. rates (high school or higher: 87.1; bachelor's or higher: 29.9). Within the region, Fajardo and Ceiba were the most educated in terms of adults with high school and college education, while Naguabo and Las Piedras had the lowest percent of their adult populations having earned a high school and bachelor's degree. The number and percent of the population with high school and college education increased significantly throughout the region from 1990 to 2010. Given Islandwide trends, the region is expected to continue to see slow but steady increases in overall educational attainment, despite declines in total population (Birston and Meléndez 2015; Duany 2015).

Table 3-36. Educational level of the population aged 25 years or more in the region surrounding El Yunque National Forest and Puerto Rico, 1990, 2000, and 2010

	Total Population > 25 years			Percent of Population > 25 years					
				High School Graduate or Higher			Bachelor's Degree or Higher		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
Canóvanas	19,629	24,911	29,770	44.2	54.9	69.3	8.2	10.9	18.7
Ceiba	9,136	10,733	9,158	60.3	66.0	70.7	10.2	16.3	22.0
Fajardo	20,668	25,203	24,231	51.3	63.2	72.6	11.7	16.2	21.5
Juncos	16,855	21,627	25,513	40.7	56.0	70.0	8.3	13.2	19.1
Las Piedras	15,121	20,324	24,916	43.8	57.0	68.2	8.7	13.1	18.2
Luquillo	9,933	11,858	13,008	50.6	59.8	70.8	11.4	17.6	17.6
Naguabo	12,326	14,120	16,840	40.5	51.9	65.7	8.4	12.3	17.6
Río Grande	24,522	31,032	35,204	47.9	59.5	70.6	11.9	13.6	19.6
Region	130,180	159,808	178,640	46.1	57.9	69.7	9.8	14.2	19.3
Puerto Rico	1,952,297	2,288,326	2,438,057	49.7	60.0	68.6	14.3	18.3	22.0

Source: (1990) Oficina del Censo, Junta de Planificación de Puerto Rico 2015; (2000, 2010) U.S. Census Bureau, American Factfinder (2015).

Income and Poverty

Personal and family income are key indicators of the overall economic conditions or well-being of a community and are important considerations in public land management decisions, particularly where

these decisions may affect income opportunities. Per capita income in the municipalities surrounding El Yunque was $9,451 in 2010, which was slightly less than that of Puerto Rico as a whole ($10,355) (table 3-37). There were fairly sizable intraregional differences in income, ranging from a per capita income of $7,548 in Naguabo to $10,409 in Río Grande, and a median family income of $18,109 in Naguabo to $24,160 in Río Grande. Overall, the municipalities in the northern part of the region (Río Grande, Canóvanas, and Luquillo) had higher median family and per capita income in 2010, followed by those in the East (Fajardo and Ceiba), while the municipalities in the southern part of the study area (Naguabo, Las Piedras, Juncos) exhibited comparatively lower income levels.

Census Information Center from the University of Puerto Rico (2017) estimates that the level of poverty increased from 44 percent before hurricanes to 52 percent by December 2017, potentially reaching 60 percent in 2018. Highest poverty rate occurs in children (under 18 years old) (57 percent pre-hurricanes) and is expected to have increased after hurricanes.

Table 3-37. Per capita and median family income in current dollars (not adjusted for inflation) of Puerto Rico and the municipalities surrounding El Yunque National Forest, select years 1970 to 2010

	1970	1980	1990	2000	2010
Per Capita Income					
Canóvanas	*	$1,650	$3,303	$5,917	$9,852
Ceiba	$1,233	$2,817	$5,119	$9,256	$9,658
Fajardo	$1,160	$1,925	$4,148	$7,852	$9,949
Juncos	$801	$1,623	$3,388	$6,369	$8,968
Las Piedras	$714	$1,627	$3,965	$6,427	$9,078
Luquillo	$861	$1,633	$3,795	$7,529	$10,506
Naguabo	$768	$1,581	$3,221	$6,960	$7,548
Río Grande	$754	$1,772	$3,529	$7,347	$10,049
Puerto Rico	$981	$2,126	$4,177	$8,185	$10,355
Median Family Income					
Canóvanas	*	$5,431	$9,499	$15,033	$24,122
Ceiba	$3,947	$7,355	$13,159	$18,851	$22,768
Fajardo	$3,574	$5,381	$10,843	$18,387	$22,095
Juncos	$2,842	$5,073	$9,144	$14,672	$20,282
Las Piedras	$2,691	$5,339	$10,251	$16,408	$20,931
Luquillo	$3,039	$5,296	$10,264	$15,203	$22,866
Naguabo	$2,350	$4,725	$8,795	$12,957	$18,109
Río Grande	$2,793	$5,980	$10,795	$17,033	$24,160
Puerto Rico	$3,063	$5,923	$9,988	$16,543	$21,764

* Canóvanas was legally designated as a municipality in September 1970, after the decennial census was conducted.
Source: (1970-1990) Oficina del Censo, Junta de Planificación de Puerto Rico 2015; (2000, 2010) U.S. Census Bureau, American Factfinder (2015).

Per capita and median family incomes in current dollars (value at the time earned/received) have increased across Puerto Rico and within the study area for several decades. However, to accurately

compare income over time, summary measures (medians, means, etc.) should be adjusted to account for changes in the cost of living (i.e., inflation) (U.S. Census Bureau 2013). When adjusted for inflation, income across Puerto Rico and within the area around El Yunque have only modestly increased since 1970 (0.66 percent per year and 0.71 percent per year from 1970 to 2010, respectively) (figure 3-9). Within the study area, Río Grande experienced the greatest average annual increase in real median family income at a rate of 1.35 percent per year over inflation from 1970 to 2010. Ceiba demonstrated the lowest growth rate in real median family income at 0.07 percent per year during this 40-year time period. Ultimately, while median family and per capita income have increased in the study area and across Puerto Rico over the past several decades, they have only modestly outpaced the rate of inflation. This slow growth in personal and family income is in large part a reflection of the sluggish Puerto Rican economy that has struggled for decades under mounting government debt and the high costs of doing business on the Island (Cohn et al. 2014; Federal Reserve Bank of New York 2012).

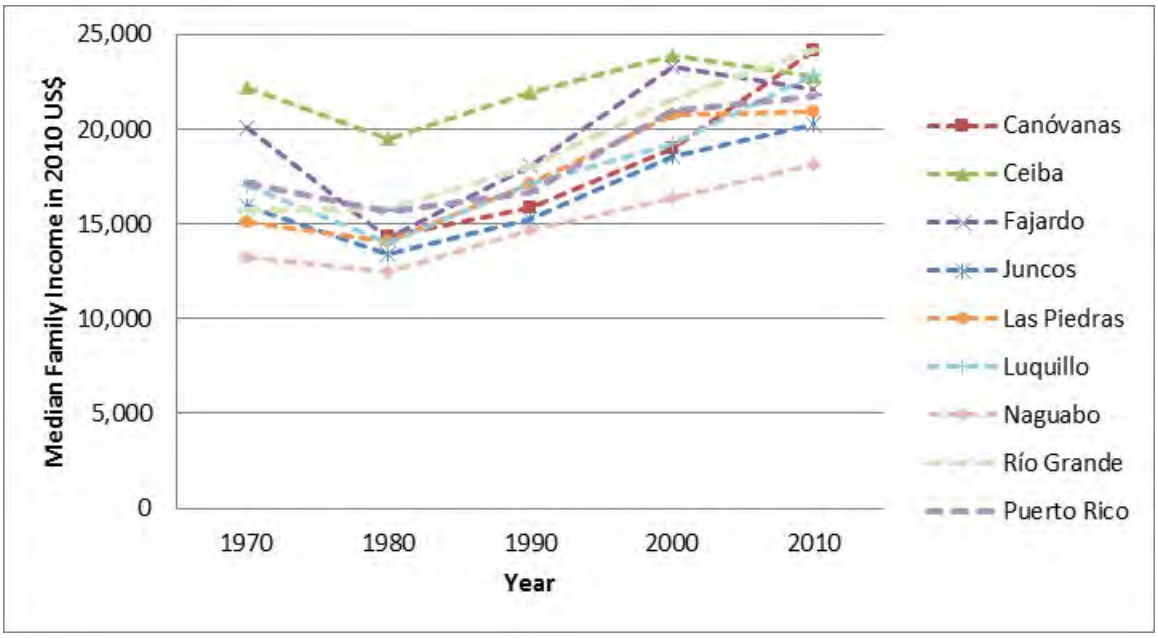


Figure 3-9. Real median family income (adjusted for inflation to the value of a U.S. dollar in 2010) of Puerto Rico and of the municipalities surrounding El Yunque National Forest, select years 1970 to 2010

Source: U.S. Census Bureau, American Factfinder (2015).

Poverty

Poverty levels are another important indicator of community well-being. In 2010, about 44.2 percent of the population in the region was living below the poverty level as defined by the U.S. Census Bureau (2015). Fairly significant intraregional differences existed, with Fajardo and Río Grande having the lowest poverty rates (42.1 percent), and Naguabo demonstrating the highest (52.6 percent). The percentages of people living below the poverty level generally have been declining throughout the region since 1970 at least, with the exception of Ceiba, which increased to 43.1 percent in 2010 from 38.6 percent in 2000 (Oficina del Censo 2015) (figure 3-10). Despite general improvements, poverty in the region and across Puerto Rico occurs at significantly higher rates than in the U.S. For example, the percent of people living in poverty in the region surrounding El Yunque in 2010 was nearly three times the national rate (14.3 percent) and almost double that of Mississippi (21 percent), which had the highest state-wide poverty rate in the U.S. in 2010 (U.S. Census Bureau 2015).

Children represent a disproportionate share of the poor in El Yunque region, as throughout Puerto Rico. In 2013, children (less than 18 years of age) represented less than 25 percent of the total population in the

region, but they represented more than 33 percent of the population living below the poverty level (figure 3-10). Of the estimated 71,912 children living in the region in 2013, 56 percent were considered to be living below the poverty level (U.S. Census Bureau 2015). Intraregional differences were notable for this variable as well, as the municipalities to the south of El Yunque along with Luquillo had higher childhood poverty rates than the other municipalities in the northern and eastern vicinities of the Forest. Naguabo had the highest childhood poverty rate at 67.5 percent in 2010. Ceiba demonstrated the greatest increase in the childhood poverty rate (0.93 percent per year) between 2000 and 2010, despite a decrease in the total number of children living in poverty. Conversely, Canóvanas and Juncos experienced the most significant decreases in childhood poverty rates between 2000 and 2010 (-0.11 and -0.65 percent per year, respectively).

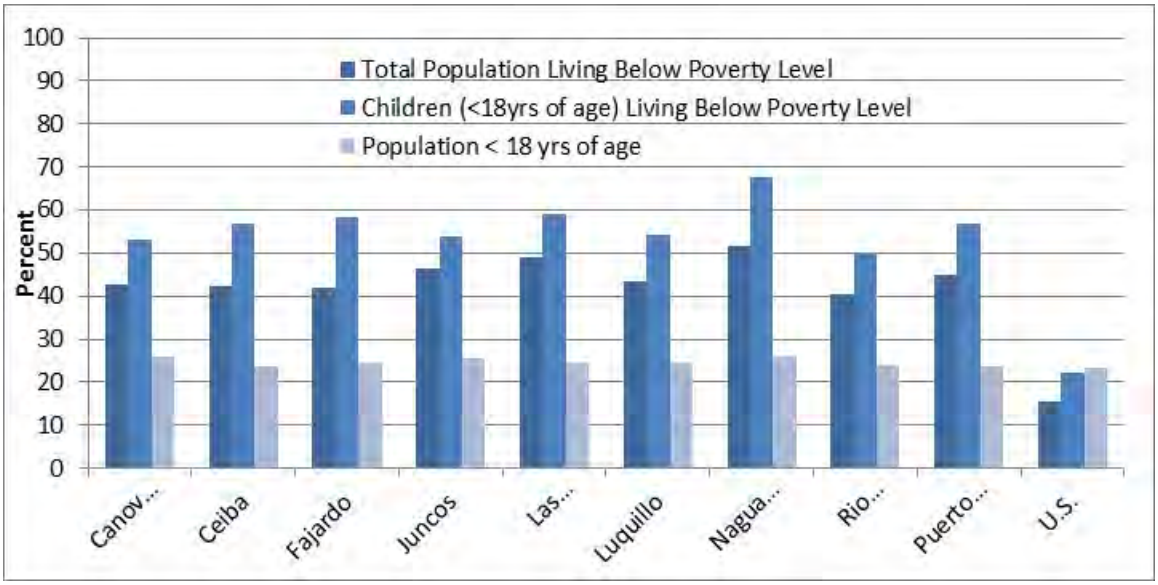


Figure 3-10. 2013 five year estimate (2009–2013) of poverty levels for the total population and persons less than 18 years of age and the percent of the total population less than 18 years of age in the region surrounding El Yunque National Forest, Puerto Rico, and the United States

Source: U.S. Census Bureau, American Factfinder (2015).

Overall, while the populations surrounding El Yunque are living longer and spending more years in formal education, which enhances the knowledge and skills available for responding to demands and changes in the social and natural environment, per capita and family income have only modestly outpaced inflation, and poverty remains high, particularly among children. Limited growth in income and persisting poverty among a large segment of the population are signs of social vulnerabilities and may be indicators of large segments of society that are being "left behind" or at risk of further decline. Low income and high poverty rates also often result in greater demands for public services and resources, including from public lands. Therefore, it is important for management decisions to account for how these community members or segments of society may be affected by changes in management direction and Forest use.

Employment and Economic Diversity

Other economic variables, such as employment rates and economic sectorialization (e.g., employment by industry sector) can be used as indicators of a community's overall economic diversity and health and community capacity to adapt to gradual or unexpected changes in the social and natural environments. In 2010, 83.2 percent of the active labor force in the area around El Yunque was employed, resulting in a 16.8 percent unemployment rate; which is similar to the Islandwide unemployment rate, but much higher than that of the U.S. (9.7 percent). About 48 percent of the regional population over 16 years of age was

actively seeking employment (i.e., in the labor force) in 2010, which is comparable to the island-wide rate (47 percent) but significantly less that the mainland active labor force rate (65 percent) in 2010. Intra-regionally, unemployment rates ranged fairly widely from 11.7 percent in Ceiba to 21.0 percent in Luquillo in 2010 (El Yunque 2014). Unemployment rates decreased throughout the area and across Puerto Rico between 2000 and 2010 (U.S. Census Bureau 2015). Ceiba demonstrated the largest reduction in its unemployment rate during this period (-0.67 percent per year), but also saw the only reduction in the number of people actively seeking employment (-0.16 percent per year) (El Yunque 2014). Most municipalities saw measurable increases in their labor forces (greater than 0.5 percent per year), with the greatest increase occurred in Canóvanas (1.41 percent per year), which also saw a significant decrease in unemployment between 2000 and 2010 (-0.58 percent per year) (El Yunque 2014).

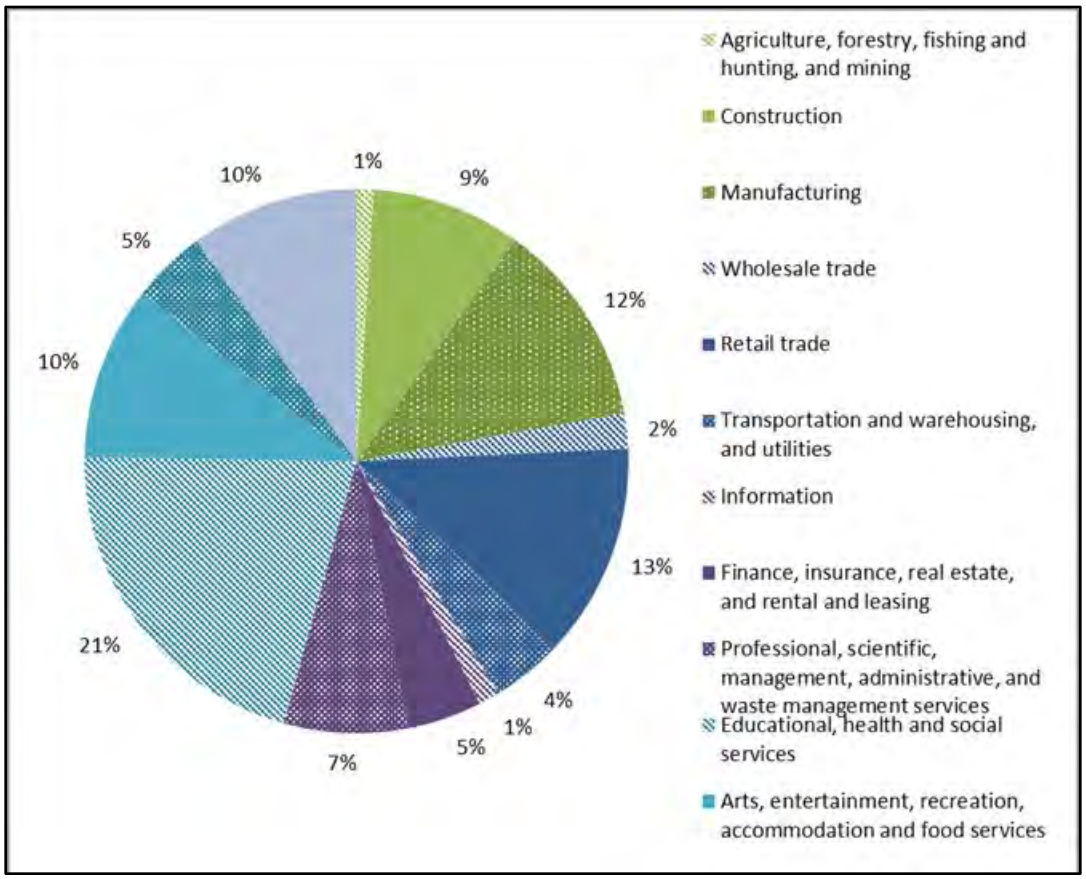


Figure 3-11. Industry by occupation for civilian employed population 16 years and older of El Yunque Region, 2010 five-year estimate (2006–2010)

Source: U.S. Census Bureau, American Factfinder (2015).

The majority of jobs in the region in 2010 were in the education, health, and social services sector (21 percent), followed by retail trade (13 percent), manufacturing (12 percent) and arts, entertainment, recreation, and accommodations (10 percent), all of which increased over the respective 2000 rates, with the exception of manufacturing (figure 3-11). Altogether, the majority of wage and salary jobs in the region in 2010 were in the service sector (77 percent). These types of jobs produce services, such as health care or education, as opposed to tangible objects, and encompass a wide range in wages and skills (e.g., doctors, chemists, software developers, restaurant workers, bus drivers). Goods producing jobs (i.e., agriculture, forestry, fishing, hunting, mining, construction, and manufacturing) accounted for 23 percent of the jobs in the region. These statistics are not so different from the U.S., where about 79 percent of jobs

were in the services industry and 21 percent of jobs were in the goods producing industry in 2010 (U.S. Census Bureau 2015).

At the municipal level, education, health, and social services jobs accounted for the greatest percent of jobs in the area, excepting in Las Piedras where manufacturing was the biggest provider of jobs in 2010 (table 3-38). And, while the agricultural industry was once a significant sector in the local economy and in Puerto Rican economy as a whole, today the sector contributes about 0.8 percent to the GDP and provides less than one percent of jobs Islandwide. Similarly, less than 1 percent of jobs within the region are attributed to agriculture, ranging from 0.45 percent in Canóvanas to 2.04 percent in Las Piedras (table 3-38).

Overall, Puerto Rico's economy has been somewhat listless for the past few decades (Cohn et al. 2014). While longstanding corporate tax breaks spurred economic and industrial growth across the Island for many years, their termination in 2006 combined with the recession in the U.S. and the larger global economic downturn and other local economic factors to produce an economic crisis from which the Island has yet to recover (Cohn et al. 2014; Federal Reserve Bank of New York 2012). Moreover, government expenditures and the Island's overall debt have increasingly exceeded revenues since the early 1990s, ultimately resulting in the downgrading of its debt to "junk" status in 2014 (Cohn et al. 2014). These factors and their effects are pronounced across the Island, including the area around El Yunque, and are reflected in part through the limited growth in income and persisting poverty among a large segment of the population. These conditions are not likely to improve anytime soon, particularly as the local and larger economies continue to languish, if not worsen, and may lead to marked changes in demands for services and resources from El Yunque and other public lands.

Table 3-38. Industry by occupation for civilian employed population 16 years and older of the municipalities surrounding El Yunque National Forest and Puerto Rico, 2010 (five year estimate 2006–2010)

	Canóvanas	Ceiba	Fajardo	Juncos	Las Piedras	Luquillo	Naguabo	Río Grande	Region
Agriculture, forestry, fishing hunting, mining	0.45%	1.27%	0.73%	0.98%	2.04%	1.50%	1.59%	0.57%	1.00%
Construction	9.47%	7.04%	6.56%	9.11%	9.03%	9.76%	15.01%	7.32%	8.89%
Manufacturing	8.52%	10.83%	7.68%	18.46%	22.78%	12.90%	11.17%	8.69%	12.29%
Wholesale trade	3.32%	0.22%	0.79%	3.46%	0.93%	0.73%	1.52%	2.78%	2.07%
Retail trade	13.25%	10.72%	15.57%	10.93%	9.07%	11.91%	14.20%	14.29%	12.77%
Transportation, warehousing, utilities	6.08%	3.40%	5.25%	2.14%	2.57%	2.65%	4.50%	5.08%	4.24%
Information	0.92%	0.77%	1.54%	1.58%	0.79%	2.44%	0.58%	1.32%	1.24%
Finance, insurance, real estate, rental leasing	4.85%	6.88%	5.53%	5.02%	4.18%	2.57%	2.20%	4.20%	4.47%
Professional, scientific, management, administrative, waste management services	6.81%	8.07%	8.45%	6.35%	9.46%	6.79%	5.88%	7.05%	7.34%
Educational, health, and social services	22.27%	26.09%	19.71%	19.99%	19.52%	21.01%	20.32%	20.83%	20.91%
Arts, entertainment, recreation, accommodation, food services	9.38%	10.74%	14.95%	5.28%	8.11%	14.17%	9.71%	11.76%	10.35%
Other services (except public administration)	4.28%	2.67%	3.68%	2.83%	5.13%	5.38%	4.44%	5.71%	4.40%
Public administration	10.40%	11.31%	9.56%	13.86%	6.39%	8.17%	8.88%	10.41%	10.01%

Source: U.S. Census Bureau, American Factfinder (2015).

Economic and Social Contributions of El Yunque National Forest

El Yunque is a complex socio-ecological system that contributes to the sustainability of local communities and society at large through a wide range of products, services, uses, and opportunities. It directly contributes to local economies through employment, expenditures, and payments. In 2012, El Yunque spent $3.53 million in salaries and non-salary expenditures and employed directly 27 full time equivalent (FTE) employees. These statistics were slightly lower than the 2008–2012 five-year average ($3.61 million in expenditures, 29 FTE employees) (see 2014 Forest Plan Assessment). Forest Service employment and expenditures represent a direct investment in the local economy and also produce significant indirect and multiplier effects by stimulating additional investment and growth in businesses that are linked to or provide support for Forest-related activities and services. The Forest also makes payments to the local government through revenue sharing and payments in lieu of taxes (2012: $150,000; $10,000, respectively). Both types of payments have decreased in recent years, but remain important sources of income for local governments and provide support for critical public services and facilities (see 2014 Forest Plan Assessment).

Table 3-39. Seven broad types of socioeconomic and cultural values and interests associated with El Yunque National Forest

Value-Interest Type	Characteristics and Examples
Recreation	Active, passive recreation; e.g., hiking, bathing, bird watching, picnicking, camping, driving
Research and Education	Science and knowledge discovery, development, and exchange; e.g., K-university educational activities, experimental and observational research, hands-on conservation
History and Heritage	Cultural and historical heritage resources and activities; e.g., resources and activities related to historic sites, interpretation, folklore, national patrimony, cultural identity
Landscape Connectivity	All lands/all communities ideology/philosophy; e.g., biophysical and sociocultural connections to public, private, agricultural lands, waterways, beaches, reefs, neighborhoods, towns, cities, etc.
Economic Opportunities	Direct, indirect economic opportunities; e.g., tourism, art, NTFPs, wood products, telecommunications, etc.
Non-market Biophysical Services	Provisioning, regulating, supporting ecosystem services; e.g., water for consumption and recreation, habitat for flora and water and air purification, carbon sequestration, soil production and erosion control, nutrient cycling, biodiversity maintenance
Non-market Sociocultural Services	Social and cultural ecosystem services; e.g., scenic integrity, religious/spiritual value, human well-being, intrinsic/existence/option values

The Forest provides a broad range of goods and services, including the provisioning of water, support for habitat for flora and fauna, regulation of air purification, maintenance of biodiversity, carbon sequestration, soil erosion control, nutrient cycling, research and education, and non-timber forest products (see for example, López-Marrero and Hermansen-Báez 2011). Some forest goods and services have been quantified. For example, water production is estimated to be valued at $25 million a year and wildlife viewing activities are estimated to generate more than $3 million a year (El Yunque 2014; Southwick 2007). Yet, most of the goods and services provided by El Yunque have not been quantified or are difficult to monetize. Moreover, while some forest goods and services benefit specific communities or areas near the Forest (i.e., place-based), the benefits derived from many of its goods and services transcend geographic or physical boundaries (i.e., interest- or value-based). Identifying and understanding

both place-based and interest-based values that individuals and groups associate with the Forest is critical to assessing the potential effects of management alternatives and actions on economic and social sustainability.

Overall, area residents and other key stakeholders attach a wide range of values and interests to El Yunque. For example, some value the Forest for the economic opportunities that it offers businesses and communities. Others value the Forest for its recreation and leisure opportunities. Finally, some appreciate the Forest for its intrinsic value of existence. The values that people associate with the Forest often are interconnected and many people value the Forest for multiple reasons. Drawing from the collaborative Forest planning process involving local communities and other Forest stakeholders associated with El Yunque and work done by López-Marrero and Hermansen-Báez (2011) on stakeholder perceptions of the Forest´s ecosystem services, we identified seven broad types of value or interest that individuals and groups associate with the Forest (table 3-39). These broad value/interest types were taken into account in our assessment of the potential consequences of proposed management alternatives, as discussed below.

3.5.1.2 Environmental Consequences

Information on the socioeconomic conditions and trends of the region surrounding El Yunque provides the baseline for examining the potential consequences of the three proposed alternative scenarios for managing the Forest going forward. For El Yunque, the analysis of potential economic and social impacts is based largely on qualitative assessment. Tools for conducting quantitative analysis, such as IMPLAN and FEAST have not been available for this Forest. Nevertheless, we can qualitatively assess the potential effects of the alternatives on socioeconomic indicators, such as employment, labor income, ecosystem services, and human values and interests, based on professional expertise and the best available scientific information. Implementation of any alternative would comply with existing rights, Federal regulations, Forest Services policies and directives, and all other related requirements. Key assumptions in the analysis include full implementation of each alternative and Forest Service budgets remaining constant across all alternatives. Actual impacts on neighboring communities and other stakeholders in the region and across the Island ultimately will depend on the uptake of opportunities provided by the Forest under any given alternative.

Effects Common to All Alternatives

Population Trends

As detailed in the "Affected Environment" section above, the region surrounding El Yunque has been associated with increasing population totals and density until very recently. Since about 2010 the population around El Yunque has begun to decrease, following the broader Islandwide trend that began around the mid-2000s. Population loss is projected to continue across Puerto Rico, including the region around the Forest, for the next decade at least (Banco Popular de Puerto Rico 2013). Despite this shift in population dynamics in the region, population density remains high. While none of the proposed alternatives is expected to influence population trends in the region or across the island in any measurable way, under all proposed alternatives, El Yunque will continue to provide open space and natural settings, as well as an array of goods and services that are important to nearby residents, various communities of interest, and society at large.

Forest Employment and Expenditures

Annual budgets for National Forests generally have been in decline in recent years and congressional appropriations that support salary and non-salary Forest expenditures have become increasingly variable. Consequently, it is difficult to forecast with any certainty El Yunque's future fiscal resources. Under each alternative, the Forest's budget will continue to be allocated among resource programs based on priorities

identified through collaborative processes, monitoring, and adaptive management. If future funding allocations remain relatively constant, the Forest is expected to continue to directly support between 25 to 30 jobs (full-time equivalents) under the three alternative management scenarios. Salary and non-salary expenditures are expected to continue to exhaust annual allocations under each of the alternatives. While fluctuations in future Forest spending may affect future economic contributions associated with El Yunque, management actions implemented under any of the three alternatives are not expected to have a measurable effect on annual funding allocations to the Forest and, as such, total Forest expenditures (including salary and non-salary expenses) are not expected to vary across alternatives. The number of indirect and induced jobs may vary across alternatives, given different management strategies, as discussed below. In particular, alternatives 2 and 3 are expected to result in more induced and/or indirect jobs than alternative 1, given their focus on collaborative strategies to develop new recreational opportunities within and around the Forest and sustainable production in and around the Community Interface Resource Management Area (CIRMA).

While implementing alternative management scenarios on El Yunque has the potential to affect local businesses and industrial sectors, the contribution of El Yunque to the local economy, and the relative differences between the alternatives, would not be large enough to cause statistically measurable changes to local economic diversity (e.g., the number of economic sectors) or economic dependency (i.e., a limited number of industries dominates the local economy). Nevertheless, alternatives 2 and 3 are expected to have positive impacts on local economic diversity and dependency as compared to alternative 1. Shifts in the local economy are likely to occur over the next 20 years or so, though not as a direct result from the actions implemented under any alternative management scenario.

Payments to Local Governments

Although the future of receipt-sharing and per-acre Federal land payment programs is uncertain, the Twenty Five Percent Fund Act of 1908 guarantees Puerto Rico a 7-year rolling average of receipts from El Yunque. A portion of this is distributed to the eight municipalities with land inside the Forest boundaries to fund local schools and roads. Revenue sharing payments are authorized through the act of May 23, 1908 (35 Stat. 260; 16 U.S.C. 500), and section 13 of the Act of March 1, 1911 (36 Stat. 963; 16 U.S.C. 500) amended by P.L. 110-343. Under all proposed alternatives, payments to the Commonwealth and municipalities would continue to help fund schools, roads, and public services, and ultimately, contribute to the sustainability and health of local communities, particularly through support for important amenities and services provided by local and Commonwealth governments.

Cumulative Effects Common to All Alternatives

As described above in the section on the affected socioeconomic environment, population and urban density near the Forest and across the Island remain high, particularly in comparison to much of the mainland U.S. High population densities and urbanization can result in increased job opportunities and better health care options as compared to rural areas, but also often implies increased demands and impacts on natural resources and the goods and services that they provide (McKinney 2002). High percentages and densities of built-up areas can alter Forest processes through fragmentation of the landscape, disruption of hydrological systems, introduction of invasive species, and interruption of nutrient cycles, among other impacts (Lugo et al. 2004). Indirectly, such increases can lead to impoverishments in the quality of recreational, spiritual, and other human interactions with nature due to the change in and/or loss of open space, natural scenery, recreational sites, and other resources (Lugo et al. 2004).

The effects of urbanization are further compounded in the context of global climate change, particularly in places like Puerto Rico, where the projected impacts of climate change are significant and where human resources and capital infrastructure to address such problems are limited. Projected sea level rise

in Puerto Rico will lead to a loss of land and infrastructure, which will likely trigger inland and upland migrations of human populations, and potentially more intensive and extensive urban development closer to the Forest edge (Lewsey et al. 2004; Kelman and West 2009). Moreover, land-use changes interact with climate change to alter fire regimes in tropical forests, such that the feedbacks between climate warming and drying and increased human development within the wildland-urban interface can increase the occurrence of and impacts from fire (Cochrane and Laurance 2008; Robbins et al. 2008). This is particularly critical for Puerto Rico, where nearly all wildfires are associated with human activity (Robbins et al. 2008).

None of the proposed alternatives is expected to influence population trends or climate change projections in any measurably significant way. Yet, all alternatives provide for the continued protection of the Forest and sustainable use of its vast array of goods and services. El Yunque encompasses the largest continuous forested area in the region, but it is surrounded by a dense patchwork of urban and peri-urban areas, agriculture, pasture, secondary forest, and other land uses. Its protection and sustainable use under all proposed alternatives will continue to alleviate some of the negative effects on quality of life that are associated with densely populated and urbanized areas, particularly in the context of a changing climate. Moreover, under all alternatives, the Forest will continue to provide a vast array of essential goods and services that benefit local communities, multiple interest groups and stakeholders, and society at large.

Alternative 1[3]

Under alternative 1, the 1997 Forest Plan will continue to guide management of the plan area. This alternative provides for increased recreation opportunities to meet current and future demands. However, in comparison to the other alternatives, the 1997 Plan does not include components oriented toward sustainable recreation opportunities and settings. This may benefit some recreation interest groups in the short term, but ultimately will lead to adverse impacts from increased, unsustainable recreation on the Forest in the long term.

Cultural and historical heritage resources are addressed through alternative 1 and would continue to be supported through existing management, but are not prioritized or enhanced through targeted management. The 1997 Plan also provides direction and support for environmentally sound tropical forestry research, contributing to some key research and education values and interests. It also emphasizes the development of environmental interpretation and education programs and products. However, in comparison to alternatives 2 and 3, alternative 1 does not specifically address opportunities for increasing environmental education and literacy at a regional level or with specific groups (e.g., schools, university groups); nor does it provide direction for the use of research and knowledge development within the context of adaptive Forest management.

Alternative 1 emphasizes the acquisition and conservation of key land units connected to the Forest, addressing some interests in landscape connectivity. Yet, it provides limited focus or direction on the broader biophysical and sociocultural connections of El Yunque within the region, as compared to the other alternatives. The 1997 Plan also emphasizes the importance of protecting water resources in terms of quantity and quality, as well as wildlife, mature forest, wilderness, and wild and scenic rivers, directly addressing values and interests associated with critical non-market biophysical and sociocultural services. However, it does not incorporate a holistic approach to managing the full spectrum of ecosystem services provided by the Forest as is proposed in alternatives 2 and 3.

[3] The cumulative effects of alternative 1 are discussed under the section on "Cumulative Effects Common to All Alternatives."

Under alternative 1, the 1997 Plan provides for economic opportunities through Forest management activities, largely associated with recreation and tourism on the Forest. It also provides for other Forest uses, such as telecommunication structures and a limited supply of wood products from timber harvest demonstrations. Nevertheless, economic opportunities under this alternative do not benefit from targeted direction to contribute to the local and larger socioeconomic environment as provided in the other alternatives.

Alternative 2

Alternative 2 takes a holistic approach to planning, emphasizing the importance of El Yunque's ecological, economic, and social resources and values to long-term sustainability. It addresses important recreation values and interests through significant enhancements to the recreation opportunities and settings offered by the Forest. Specifically, it differs from alternative 1 in its development of a recreation corridor along PR Road 191, a Scenic Byway along PR Road 186, and a Community Interface Resource Management Area (CIRMA), where multiple sustainable uses, including passive and active recreation can be developed and carried out in collaboration with nearby communities and governments. Under this plan direction, recreation activities will be dispersed to lower elevations of the Forest, alleviating some of the existing pressures of intense uses along PR Road 191, and ultimately allowing for more sustainable levels of recreation throughout the Forest and satisfying a broader range of recreation values and interests.

Unique to alternative 2, is the identification of three geographic areas (El Norte, El Suroeste, and El Este) to enhance the development of integrated management strategies that tie to the distinct conditions that exist at the subregional level around the Forest, which increases the Forest's effects on a broad range of value and interests. Alternative 2 calls for focused attention on increased access to recreation settings and connections to a regional trail system in El Norte GA, on community-based use of the Forest and increased environmental education and community enterprises in El Suroeste GA, and on watershed management in El Este.

Under alternative 2, research and education interests are supported through multiple components and strategies, including management areas designated for on-going, long-term research (Bisley, El Verde, Baño de Oro) and Forest monitoring as a fundamental part of adaptive management. This alternative goes beyond alternative 1 in its plan components related to environmental education, specifically in terms of its focus on enhancing environmental literacy in neighboring communities, local schools, and society at large. Alternative 2 also proposes enhanced interpretation efforts associated with natural and cultural resources. It addresses cultural and historical heritage interests and values through the prioritization and targeted management of important resources and sites. It also promotes cultural identity, national patrimony, and folklore associated with the Forest and its history. Altogether, these efforts promote greater awareness and understanding of the Forest's diverse resources and services and increasingly sustainable use and protection of these resources and services by a widening range of stakeholders. Overall, this alternative greatly enhances access to information and education to local communities, other key stakeholders, and the public-at-large.

Landscape connectivity interests and values are supported through an "all-lands" approach to forest management, conservation, and restoration under alternative 2, particularly through the development of the CIRMA and the identification of three geographic areas. Alternative 2 goes beyond alternative 1 in supporting biophysical and sociocultural connections across the broader landscape, specifically through the identification of geographic areas where targeted conservation initiatives may be developed, such as for stream corridors, riparian zones, connections to other public lands and protected areas, facilitating the identification and protection of critical connections and developments at the sub-regional level. Alternative 2 also promotes and provides greater access to existing and new economic opportunities tied to the Forest, particularly through the development or demonstration of multiple, sustainable uses in the

CIRMA and nearby communities, and through management strategies that support community collaboration and development, and ultimately lead not only to the creation of indirect and induced jobs but also enhanced stewardship of the Forest and its goods and services.

Alternative 2 directly integrates plan components focused on the protection and promotion of the ecosystem services provided by El Yunque, addressing a broad range of interests and values associated with its non-market biophysical and sociocultural resources and processes. It enhances protection and monitoring of the Forest's provisioning, regulating, and supporting services, as well as its scenic integrity, intrinsic values and other sociocultural services. Additionally, through management strategies that promote participation and collaboration, this alternative contributes to reduced impacts on sensitive areas through dispersed recreation and increased restoration in specific areas. Moreover, management of invasive species throughout the Forest may contribute to some key non-market biophysical services values and interests, as well as provide new and additional economic opportunities.

Alternative 3

Alternative 3 is similar to alternative 2, with the exception of a few key areas. First, it does not recommend the designation of a Scenic Byway along PR Road 186 and differs from Alternative 2 in further reducing the impacts from recreation, particularly through the elimination of trails that cannot be maintained. These differences may affect hikers, birders, bathers, and other recreation stakeholders. Also, Alternative 3 recommends the designation of a new wilderness area, in the existing Baño de Oro Research Natural Area, which may serve recreation and non-market services interests and values, but impact research and education stakeholders. This alternative decreases the scope of invasive species management (managing at identified sites like road right-of-ways, recreation areas, and threatened or endangered species habitats) as compared to alternative 2 (managing throughout El Yunque), though still greater than alternative 1. Finally, alternative 3 identifies two geographic areas (El Norte, El Sur) in which integrated management strategies may be developed in line with the conditions that exist at the subregional level around the Forest and enhancing the Forest's overall effects on a broad range of value and interests.

3.5.2 Land Use and Ownership

3.5.2.1 Affected Environment

Approximately 29,000 acres of El Yunque National Forest are located in the municipalities of Canovanas, Rio Grande, Luquillo, Fajardo, Cieba, Juncos, Las Piedras, and Naguabo. The lands program area includes several different activities. Affected environment and environmental consequences on land exchanges, purchases, boundary management, and other activities are primarily real estate-type activities. Special uses activities include authorizations to use National Forest System lands for non-Federal type uses. These uses can include utility corridors, private and public roadways, communications sites, or signs. Actions and plans of local communities and their growth and development influence El Yunque National Forest through land adjustment cases, land exchange concerns, utility needs and development, and residential impacts. These communities are also partners in maintaining and acquiring open space and providing needed services to residents and Forest users. The Forest Service may acquire lands through exchange, purchase, donation, or condemnation. Land exchange and land purchase have been, and would continue to be, the means by which El Yunque National Forest acquires key wildland resources and open space areas. Most of the Federal lands exchanged are within or near existing communities and the majority of land conveyed to the Forest, as a result, is located in more remote areas. Procedures for processing cases and public participation is determined by set policies, rules and regulations outside the Forest Plan and would apply regardless of the alternative selected.

3.5.2.2 Environmental Consequences

All Alternatives

Criteria for land adjustment cases are very similar among all alternatives. Public concern about being involved early in land exchange projects and continued support for community needs would be addressed in all alternatives. As a result, the public would be informed of land exchanges early enough to meaningfully contribute to the outcome for the benefit of the community. This would increase trust in the Forest Service's lands program. Due to budgetary constraints, limitations of the plan and community influences, the Forest would likely continue to increase in acreage, but probably at a small rate throughout the life of the plan.

Given the increasing concern of local communities regarding Forest and other open space fragmentation in the region, all alternatives are likely to produce increased public awareness and landscape conservation through land acquisition and environmental education.

Under each alternative, the Forest would continue to pursue the acquisition of additional acres to add to the existing footprint of the Forest, with a primary focus on lands containing riparian zones along with rivers and streams to maintain and conserve water quality from the Forest to its connection to the sea. Lands would be evaluated for disposal and acquisition based on criteria developed in the Forest land ownership and acquisition strategy. Emphasis would continue to concentrate on lands with valuable recreation, wildlife habitat, or other natural resource attributes. Acreages such as those found in wilderness or other designated sites would not be considered for conveyance.

Alternative 1

El Yunque National Forest Land Ownership and Acquisition Plan lists specific attributes and tracts to acquire—many of which have been acquired. However, the list has not been modified to keep up with adjustments. Other acquisition parcels are not listed and, therefore, may not be perceived as high priority. Parcels of importance would change throughout the life of the plan as resource values are discovered (archaeology resources) and identified, interested parties come forward, or additional species are listed or conditions change.

Land and Water Conservation Fund priority direction is contained in policy and ranking criteria, and this wording is no longer needed in the plan. The criteria of lands to acquire would continue to be effective for determining potential purchase cases instead of a list of priority properties.

Because this direction is redundant with Forest Service policy, it does not contribute to effects.

The plan states specific boundary and landline direction, but timeframes do not reflect current limitations in budget and the flexibility of the Forest to determine priority work. As a result, this direction would remain unachievable.

Alternative 2

Conservation easements and other land conservation and restoration programs under alternative 2 can lead to increases in lands dedicated to ecological conservation and restoration and in reductions in land fragmentation in the region surrounding the Forest.

Environmental education and agroforestry projects that can be developed within the Community Interface Resource Management Area (CIRMA) and promoted in neighboring lands under alternative 2 will contribute to enhanced agricultural, forestry, and other land use practices and lead to increases in recreation and employment opportunities.

This alternative includes guidelines that would likely result in similar land adjustment opportunities identified in El Yunque National Forest Land Ownership and Adjustment Strategy. Including conveyance of inholdings that do not possess characteristics that would further the Forest Service mission and increase the ability to acquire non-National Forest System lands containing habitat for threatened, endangered, or sensitive species and consolidate Federal ownership.

Working collaboratively with local governments and communities early on the land exchange projects per the associated management approach may result in land exchanges being developed that meet communities and Forest needs and parties agreeing to potential tradeoffs of open space values for other resource benefits.

Alternative 2 would continue to allow for conveyance of lands to meet community and public needs and would add loss of wildland character to the list of lands that could be conveyed. This could provide incentives for non-Federal neighbors to protect those values to reduce the potential for land exchange or sale. This alternative would also add Forestwide emphasis to management approaches for collaboration with private landowners and local governments to protect Forest values from adjacent development impacts. This could result in less habitat fragmentation and greater watershed health to Forest resources from adjacent non-Federal uses by developing buffers on private lands. Characteristics of lands to acquire would be stated in the guidelines and priorities would be set using a ranking system in the Forest Service Handbook. Boundary survey and encroachments would not be specifically mentioned in alternative 2, but would still be part of a lands program and would be addressed according to policy and regulation and should not change current management.

Overall, alternative 2 would be substantially different from the 1997 Plan. Adjustments of guidelines and desired conditions would reflect more succinctly the criteria of lands desired for Federal acquisition and those appropriate for conveyance. Values would be included to address local concerns about land exchanges that result in conveyance of National Forest System lands. Loss of wildland character as a conveyance characteristic would be a good communication tool with adjacent non-Federal owners who can work to protect those values, perhaps reducing encroachment cases. This would allow communities to identify important open space, but also to take some responsibility for preserving wildland and resource values. If land adjustment actions are consistent with the guidelines, key resource value properties would be acquired and would result in meeting the desired condition of a mostly contiguous land base that provides for biologically diverse public lands.

Alternative 3

This alternative is similar to alternative 2 except for additional congressionally designated wilderness area. These acres would be permanently removed from consideration for conveyance.

Cumulative Effects, All Alternatives

The cumulative environmental consequences are spatially bounded by an area larger than El Yunque National Forest proclaimed boundary, generally the area immediately adjacent El Yunque National Forest. While population has demonstrated a decrease Islandwide since the early 2000s and more recently in the region surrounding the Forest since about 2010, land use change for development, tourism, exurban growth, and other factors may continue to affect the Forest and surrounding natural areas.

If private properties, especially inholdings change from rural or undeveloped land to subdivisions or higher density uses, residential encroachments on the Forest are expected to occur more frequently and degrade wildland character and other resource values, requiring additional land survey needs. If development increases and/or encroachment occurs, undeveloped lands and their open space values are converted to residential or commercial uses. This growth would likely result in continued pressures to

maintain National Forest System lands for their open space values. This may also trigger the need to acquire rights-of-way in places where informal public access is lost to development. Working with other governmental partners on ordinances and plans under alternative 2 could continue to reduce potential impacts to Forest resources.

All communities adjacent to El Yunque recognize the open space and recreational values the Forest provides and have developed goals and objectives in their plans to preserve these characteristics. Entities like Puerto Rico Tourism Company, Center for Landscape Conservation, the Coalition Pro-Northeast Corridor as well as other partners can assist in acquiring key parcels that would help retain water resources and habitat for desired conditions for fish and other wildlife species. There may be additional tradeoffs of resource values on the Forest as local communities change demographically. There would also continue to be tension between the desires to retain National Forest System land near communities and the need to provide land for infrastructure for community expansion. Local collaboration expectations with communities and their desire for open space may result in localized exchanges. However, all alternatives acknowledge community needs and the locations where land adjustments are appropriate and minimize impacts.

3.5.3 Forest Products

3.5.3.1 Introduction

Timber Forest Products

Planned harvests would only occur on lands "suitable for timber production." The identification of lands as "suitable for timber production" does not mean that timber production is the primary purpose of management on those lands; rather, the production of wood products is compatible with the achievement of desired conditions and objectives established by the plan for those lands (36 CFR 219.11(a)(1)(iii)), and some regular flow of wood products may be expected.

Following natural disturbance events the removal of dead or damaged trees could also occur on lands identified as "not suited for timber production because timber production is not compatible with the desired conditions" (see table 3-40).

Table 3-40. Timber production suitability classification for alternatives 2 and 3

Land Classification Category	Acres
A. Total National Forest System lands	28,223
B. Lands not suited for timber production due to legal availability or technical considerations	17,752
Wilderness	10,352
Slopes over 30 percent (outside of wilderness)	7,400
C. Lands that may be suited for timber production (A- B)	10,471
D. Lands not suited for timber production because timber production is not compatible with the desired conditions and objectives established by the Plan	3,284
E. Lands suited for timber production (C- D)	7,187
F. Lands not suited for timber production (B+D)	21,036

The vegetation types, wildlife, and physical conditions impose non-suitability of the lands. In table 3-40, lands outside of the wilderness area, but on slopes greater than 30 percent, are identified as "not suited for timber production," because these lands are easily prone to landslides during heavy rains. The lands in category D (where timber production is not compatible with the Plan's desired conditions) are the lands found within the existing and expanded research natural area. The only acres that are identified as "suitable for timber production" are those within the Community Interface Resource Management Area (MA 4).

For alternative 1, the lands in category D (where timber production is not compatible with the Plan's desired conditions) are all the lands that "may be suited for timber production" except for the lands in the Timber Demonstration Management Area, which comprise the only acres "suitable for timber production." Note that while the 1997 Forest Plan had these timber demonstration acres classified as "not suitable for timber production," it was decided that under the new understanding of what lands should be identified as "suitable for timber production" that these lands should now fall into that category.

Timber harvest and the production of wood products can play an important role in attaining desired conditions for ecological sustainability and can contribute to local social and economic sustainability. While the assessment identifies and evaluates how timber harvest and production contribute to social, economic, and ecological sustainability, there is no timber program on the Forest or the region. The 1997 Plan did allocate 1,167 acres for a silvicultural demonstration program; this is continued in alternative 1. However, no harvesting has occurred and timber utilization has been limited to salvage of dead and down trees basically for wood crafters and artisans.

Alternatives 2 and 3 recognize that there is a local, non-commercial demand for wood products within the arts and crafts community. There are more than 600 artisans certified by the Puerto Rico Economic Development Administration. Most of the Island's practicing artisans that work with wood use mainly locally available lumber resources that are harvested for that purpose, and milled in private sawmills (Kicliter 1997). Artisans' state that the supply of wood is very scarce, difficult to maintain, and expensive (Kicliter 1997). Consequently, these alternatives promote the production of local wood products within the community interface resource management areas (CIRMA).

Table 3-41. Timber production suitability classification for alternative 1

Land Classification Category	Acres
A. Total National Forest System lands	28,223
B. Lands not suited for timber production due to legal availability or technical considerations	17,752
Wilderness	10,352
Slopes over 30 percent (outside of wilderness)	7,400
C. Lands that may be suited for timber production (A- B)	10,471
D. Lands not suited for timber production because timber production is not compatible with the desired conditions and objectives established by the Plan	9,304
E. Lands suited for timber production (C- D)	1,167
F. Lands not suited for timber production (B+D)	27,056

The type of wood products that might be produced from the CIRMA management area would be small-diameter timber (<8 inches or 20.3 centimeters of DBH) used mainly as poles, posts, carvings and other

biological material harvested from within and on the edges of Forests that regenerates naturally on lands abandoned after non-forested uses, and manipulated or disturbed Forests.

Forest Yield

Most of the suitable Forest land is dominated by secondary stands in the process of separating into a maturing canopy structure. Typically, this Forest integrates three canopy levels at its mature stage. About 32 species of the 150 species identified in secondary stands are recognized as species with timber use value. The other species have added potential uses in relation to special forest products and are important for the ecological settings that these Forests provide in El Yunque. To establish a sustainable yield capacity, the growth rate of the species that dominate the suitable Forest lands need to be considered as part of the wood utilization initiatives. Growth rate in the subtropical wet, subtropical rain, lower montane wet, and lower montane rain forest life zones of the Luquillo Mountains of Puerto Rico has been studied (Crow and Weaver 1977; Schmidt and Weaver 1981; Weaver 1979; Weaver and Birdsey 1990). In 2009, Brandeis published a report titled "Diameter Growth of Subtropical Trees in Puerto Rico" in which the growth among trees measured in the Forest inventories of Puerto Rico were calculated by annual increase for the period considered in the Forest Inventory Analysis (FIA). The document presents the periodic annual increment or PAI in tree diameters at breast height (DBH). The suitable Forest lands include a small area of subtropical moist forest and most of it is in the subtropical wet forest according to Ewel and Whitmore (1973). Table 3-42 from Brandeis (2009) shows the mean increment by life zones documenting similar PAI in the Subtropical Moist and Wet Rain Forests.

Brandeis (2009) also provides the periodic annual increments measured by species as part of the appendix of the document. This information will be used in the evaluation of potential silvicultural applications to sustain the potential growth of selected species.

Table 3-42. Diameter at breast height (1.4 meters) periodic annual increments by Holdridge life zone with number of trees measured, standard error of the mean, standard deviation of the mean, and maximum observed periodic annual increments increase from Puerto Rico forest inventory data in cm/year

Life Zone	N	Mean	SE	SD	Maximum
Subtropical Dry	307	0.20	0.03	0.45	5.74
Subtropical Moist	2,315	0.37	0.01	0.48	4.30
Subtropical Wet/rain	1,292	0.36	0.01	0.51	5.84
Lower Montane	112	0.20	0.02	0.24	1.28
All Life Zones	4,026	0.35	0.01	0.49	5.84

N = number of trees measured; SE = standard error of the mean; SD = standard deviation of the mean; Max = maximum observed.

Planned Wood Product Sale Program

In alternatives 2 and 3, the amount of wood products expected from the CIRMA will fluctuate, depending on the previous silvicultural treatments that may have been applied in the area. After a review of several compartment examination and prescription reports prepared in El Yunque, extreme variation from secondary forest to climatic Tabonuco-type forests was evident. Before the pass of hurricanes Irma and María, in September 2017, the understory density in Tabonuco type forests was generally lower with reports of 49 trees per acre in the DBH range of 4 to 16 inches (10 to 40 centimeters) (Stand 12 Compartment 1 Sabana) and in stands with secondary forests, the immature commercial species were reported at a rate of 100 trees per acre in the 4 to 12 inches (10 to 30 centimeter) DBH range.

The specific volume of production of stands throughout the CIRMA will also vary depending on the forest structure, previous treatments, site quality, and the response of the areas to natural disturbances.

Alternative 1, which will continue the level of harvest from that estimated in the 1997 Plan, was estimated to be 22 acres per year for the first decade with 23 MCF (651 cubic meters) per year of yield (Table II-3, 1997 Plan FEIS). The number of acres per year was based on a scaled-down demonstration of forest products on 1,100 acres (about 4 percent of the Forest). For alternatives 2 and 3, even though there are 7,187 acres in the CIRMA where scheduled timber harvesting activities could occur, for the first two decades it has been determined that the level of harvesting activity from that estimated in the 1997 Forest Plan is the level that should be continued within the CIRMA. The silvicultural prescription considered for stands in the CIRMA would plan for a stand to be entered every 50 years. So 1,100 acres ÷ 50 = 22 acres to be treated per year. The yield of 1.045 MCF/acre (10.45 CCF/acre or 29.57 cubic meters/acre [where 1 cubic foot = .0283 cubic meters]) from the 1997 Forest Plan will also be used for the yield projections for all the alternatives. This will result in a total projected yield of 23 MCF/year (22 acres x 1.045 = 23 MCF [651 cubic meters]) or 230 MCF per decade. The ten year projections for the alternatives are shown in table 3-43. The integration of other forest products from agroforestry activities is incorporated into these yields and a review of the projected harvest acres per year and yields will be conducted after the first 5 years of plan implementation. It is also important to recognize that this planned wood products program is long-term (over the life of the Forest Plan). However, some of these activities may not occur until after the timber salvaged from Hurricane Maria is used.

Table 3-43. Projected wood sale quantity, and projected acres treated by alternative

	Alternative 1 1st Decade	Alternative 1 2nd Decade	Alternative 2 1st Decade	Alternative 2 2nd Decade
Projected Wood Sale Quantity in MCF (annually)	23	23	23	23
Acres Treated by Uneven-Aged Management or Thinning (annually)	22	22	22	22

Sustained Yield Limit

The sustained yield limit (SYL) is an estimate of the quantity of timber that can be removed annually in perpetuity on a sustained-yield basis (see 36 CFR 219.11(d)(6)). The sustained yield limit is also determined based on the total "lands that may be suited for timber production," which from table 3-41 is 10,471 acres. For El Yunque, the sustainable limit is the amount of timber that can be removed without exceeding the established level of annual growth. Silvicultural treatments in the Forest with structure and composition similar to the CIRMA forests in Puerto Rico has shown possibilities for a significant increase in the representation of promising tree species (Wadsworth 1986). The annual growth documented in this type of forests is 3 to 4 cubic meters per hectare per year (or 1.6 cubic meters per acre per year) (Wadsworth 1986). Where 1 cubic meter = 35.3 cubic feet, this converts to 56.5 cubic feet per acre/year (or 0.565 CCF/acre/year). The sustained yield limit for El Yunque is therefore 56.5 cubic feet/acre ´ 10,471 acres = 591,612 cubic feet per year or 591.6 MCF per year.

Non-timber Forest Products

There are several plant products (non-timber forest products) requested year-around and managed via free use permits. These products are mostly for personal consumption. Those products that are requested for commercial use are managed via small products forest sale permits; usually these include Heliconea flowers and dead tree fern stems of *Cyathea arborea*.

During Christmas season there are many requests for ñame (yams), yautia (tanier), malanga (taro) and bananas. All of these consumption products are vegetation persistent from past agricultural practices or

from home gardens that existed prior to the 1920s when the lands were acquired by the Federal Government. These products are harvested yearly from the same location; with the root crops and the regenerative parts planted back in the same location for next year's harvest.

For home decoration and Christmas tree manufacture, the fallen leaves of the *Cecropia* tree are solicited during the season. As mentioned, dead and down trees are permitted to artisans, wood crafters or even for fire wood.

The permits generated by El Yunque are in the average of 30 per year and are administered from the reception desk at the Forest headquarters building. Most of the users are from the adjacent communities of El Yunque.

Other non-timber special forest products that may be provided from El Yunque include such products as (1) foods, such as wild edible mushrooms, native fruits, and nuts; (2) medicinal plants and fungi; (3) floral greenery and horticultural stock; (4) fiber and dye plants, lichens, and fungi; (5) oils, resins, and other chemical extracts from plants, lichens, and fungi.

While these products can be provided through the use of a special forest product permit, there are strict limitations with the use of these permits. Special forest product permits can only be used for products that can be managed on a sustainable basis, and the amounts offered are limited to the amount that can be harvested annually in perpetuity (see 36 CFR 223.219).

3.5.3.2 Environmental Consequences

Alternative 1

Alternative 1 continues the allocation of 1,167 acres to the demonstration of sustainable timber production with 120 acres of roadside demonstration plots (1997 Plan, pages II-18). These lands would be used to demonstrate how sustainable timber production could be achieved while still being compatible with the protection of the other Forest resources. Under this alternative, only 22 acres would be harvested each year. The timber products that would be available would primarily be posts, poles, and firewood.

Alternatives 2 and 3

Alternatives 2 and 3 allocate 7,187 acres of land for timber forest products. There is an increase of 6,020 acres due to the creation of the community interface resource management area (CIRMA). The CIRMA provides opportunities for forest product utilization strategies that can be coordinated with community groups and residents neighboring these areas. The CIRMA management activities represent a shift from the more traditional forms of timber management as would occur in alternative 1, to a more collaborative management approach dependent on providing the types of wood products and special forest products that the local communities and local artisans have a demand for. While it is estimated that the acres treated and the total wood volume (in MCF) that would be produced would be the same for all three alternatives, the silvicultural treatments and the types of wood products that would be provided would be different under alternatives 2 and 3 than what would occur under alternative 1.

The issuance of non-timber forest products permits could also increase because the acres available in the CIRMA in alternatives 2 and 3 (7,187 acres) is considerably larger than the lands available in alternative 1 in the timber demonstration management area (1,167 acres).

3.5.4 Cultural Resources

The presence of humans in El Yunque can be traced back almost a thousand years. During this period of time different groups, such as the Ostionan Ostionoid (pre-Tainos) and the Chican Ostionoid (known as Taínos), inhabited the zone surrounding the Luquillo Mountains.

The majority of prehistoric activity in the Forest has been identified in the shape of petroglyphs located in the lower elevations of the Forest, mostly under the 600-meter elevation. Such petroglyphs are not only remains of past activities, but artistic expressions of the Prehistoric people's set of beliefs and ideas about the world, and the supernatural world.

More systematic studies of the forestlands are required to document other prehistoric-era sites such as settlements or places of resource extraction.

European conquest and colonization of the Island of Borikén began by the end of the 15th Century, with colonization reaching the Luquillo Mountains by the early 1500s (Domínguez-Cristobal 2000; Weaver 2012). The direct effects of colonization were the decimation of indigenous population, and the annihilation of their socio-political structures and religion.

In part, this transformation was a direct result of mining activities established by Spaniards on the Island during the first three decades of colonization (Domínguez-Cristobal 2000). Mining was the most important economic activity during the early 16th Century, including the eastern mountains (Weaver 2012).

Small settlements took hold in the lower elevations of El Yunque. These consisted of clustered rural communities and small dispersed households. Economic exploitation of El Yunque area continued between the 16th and 19th Century in the form of subsistence farming, and small-scale crop production such as coffee, tobacco, and sugar cane harvesting. Timber was one of the main product staples extracted from the Forest. These patterns along with the growing demand for wood used in construction, fuel, and ship building, mixed with, "poor agricultural farming practices, political instability, lack of communication between the metropolitan centers and the rural population and a scarcity of personnel and budget for forestry activities" resulted in the decimation of many primary forestlands across the Island; including some parts of the Luquillo Forest (Domínguez-Cristobal 2000; Weaver 2012). The origins of what we now call El Yunque and its conservation efforts are linked to several land use polices promoted by the Spanish Crown during the 19th Century. In 1876, King Alfonso XII issued the "Ordenanza de Montes," an ordinance that set the framework for the functioning of all Forest management activity on the Island. It is through this ordinance that the Inspección de Montes was created; an entity in charge of the management of Crown lands, including approximately 10,000 hectares pertaining to La Comarca de Luquillo designated as a watershed, soil, and timber reservation (Domínguez-Cristobal 2000; Valdés-Pizzini et al. 2000; Weaver 2012).

After the Spanish American War, and having Puerto Rico being transferred to the United States, the Americans installed a new colonial rule. The new political regime resulted in the adoption of an alternative management framework for those lands pertaining to the Spanish Crown, including El Yunque. Subsequently in 1903, President Theodore Roosevelt proclaimed the transferred Crown lands as the Luquillo Forest Reserve. The original proclamation boundary encompassed about 25,650 hectares classified as public Forest as soon as the government might acquire the lands; later, the boundary was modified (Weaver 2012, page 9). Since then, the Forest Service has been responsible for the management of the reserve. The first half of the 20th Century marked a major shift in the management policies implemented in El Yunque. After the Forest Service acquired the old Spanish Reserve they allowed the Parceleros to remain in place to "intercrop foodstuff with trees (a system called taungya or agroforestry)

gradually reforesting Federal lands" (Weaver 2012). Slowly they were relocated to lands outside the Forest from the 1930s on.

With the start of the Great Depression Puerto Rico was heavily affected, in large part because of the prevailing Parcelero system, the lack of employment, and the overall poverty that was prevalent on the Island since prior to the economic collapse. The result of the initiatives promoted by the Roosevelt New Deal during the Great Depression brought to El Yunque the Civilian Conservation Corps (CCC) in 1935 (Valdés-Pizzinni et al. 2011). This program promoted temporary economic relief through the recruitment of young men that would be hired to engage in different reforestation, construction, and renovation projects in Federal and National Forests. Possibly the largest contributions of the CCC the construction of the main access and recreational infrastructure used in the Forest to this day. The CCC generated a new image of the Forest as the "recreational reconstruction of the forest" (Valdés-Pizzinni et al. 2011). Most of the Forest's recreational manmade landmarks date to this period. Such infrastructure would subsequently make possible the steady increase in visitation of the Forest in the post- depression/post-war period. This CCC work was significant in introducing the urban building construction technique of reinforced concrete and architectural style elements into rural forest recreation settings throughout the island.

The CCC period also coincide with the beginnings of the scientific experimental initiatives and the military use of the Forest. In 1939 the Tropical Forest Experiment Station (Valdés-Pizzinni et al. 2011). The Experimental Station (renamed Institute of Tropical Forestry in 1960) centered its efforts in research on tropical forestry and continues to serve as one of the primary research centers of its type until the current date.

In 1942, the U.S. Army established a "warning radar system" at El Yunque Peak. Other military used of the Forest included maneuver practices in jungle warfare (Wadsworth 2014).

During the 1940s the Puerto Rican Government launched Operation Bootstrap, a strategy to promote the modernization and industrialization of the Island. With the Operation, lands that were once used for agricultural activity were either abandoned or sold for the construction of new suburbs, town houses, and related economic activity. The suburbanization of El Yunque periphery resulted in a rapid population increase in some of the municipalities within the region. However, despite this trend, El Yunque remained important for local residents and tourists in search of a pleasant aesthetic experience and a direct contact with nature.

3.5.4.1 Affected Environment

Archaeological investigations in the area of El Yunque and surrounding municipalities date back to the late 19th Century when aficionados started recording some existing prehistoric sites around El Yunque. In the years following the transfer of sovereignty after the Spanish-American War, various scientists came to the Island as part of various scientific expeditions. Such academic endeavors, although producing some of the most significant research on Puerto Rican prehistory to this date, did not focus their attention on the lands that are now El Yunque National Forest. It is not until a decade after the passing of the National Historic Preservation Act (NHPA) in 1966 that serious archaeological research commences on the Forest. In the early 1980s various surveys of the different timber stands included the description of archaeological sites found during timber inventory work. By then archaeological areas of relevance had extended beyond interest in prehistory to include sites from the historic period such as Parcelero homesteads, Haciendas, and CCC-era infrastructure. In 1981, the Forest completed a comprehensive literature search that documented all reported cultural sites known within the forestlands (Daubon 1981). By the mid-1980s, proper archaeological work was being conducted by a Forest archaeologist, archaeology technicians, and para-professionals. The work carried out in compliance with the various sections of the NHPA continues to this date. In 2003, a Centennial Timeline summarizing the history of

the Forest was completed. In 2005, a multi-property National Register Nomination titled the New Deal Era Properties was completed and accepted by the Advisory Council on Historic Preservation. The multi-property nomination centered on the Civilian Conservation Corp infrastructure on the Forest, which was completed with the aim of providing a historical context and stylistic framework which would facilitate the independent nomination of CCC-era properties in the Forest.

Some form of archaeological survey has been completed on about one third of El Yunque National Forest. Much of such survey was conducted prior to the mid-1990s in support of improvement activities, land acquisitions, road and trail maintenance, and recreation development. This means that the criteria for testing many of these areas might have not responded to their archaeological potential, or to current scientific standards. Various areas have also been independently assessed as part of NHPA Section 106 consultation prior to independent project implementation.

The result of the archaeological work has been the discovery of many historical and archaeological resources. A total of 172 sites are listed for El Yunque as of fiscal year 2015. In the aftermath of hurricane Irma and Maria in late 2017, a few new archaeological sites or new features of historic properties were discovered and were documented, including one World War 2 era toilet facilities at La Mina Recreation Area. The NHPA requires that all buildings, structures, archaeological sites, objects and other cultural resources be evaluated and managed as significant or non-significant assets (eligible or not-eligible as per the legislation's wording). To reach such determination of significance the independent resources are evaluated based on their historic context, criteria of significance, and integrity in a multiparty consultation process.

So far 46 sites have been evaluated or partially evaluated and found eligible for inclusion in the National Register of Historic Places at the agency level. Formal concurrence from the State Historic Preservation Officer (SHPO) is required to cement the eligibility status in many of the cases. A total of 22 sites has been evaluated and found not eligible and 104 sites are pending a formal evaluation of eligibility. Of all the eligible properties only one prehistoric petroglyph site has been nominated and listed on the National Register of Historic Places.

Of the 33 sites listed in the New Deal Era Multi-property Nomination Form, ten have been deemed eligible by the agency, with two of them having official concurrence from the SHPO on that determination. One site was destroyed and thus is considered not eligible, while 22 are pending an eligibility determination. Of the 33, none has been independently listed.

The passing of hurricanes Irma and Maria in late 2017 caused damages to many of the historic properties on the Forest, mostly to the New Deal Era buildings strowned across the Forest. Most of the damage was limited to features of the building such as doors, windows and ceilings, and some limited structural damage to the fabric of the properties caused by falling vegetation. Structural damage was more severe on the historic trails and roads where a number of severe landslides and bed failures will necessitate reconstruction or rerouting of the resources. Prehistoric sites were not adversely affected at this time by the weather events. Emergency cleanup after the hurricanes helped safeguard the integrity of the properties, in many instances addressing the accumulated deferred maintenance needs of the sites. Further restoration efforts are required to address the damages to the properties.

3.5.4.2 Environmental Consequences

All Alternatives

Proposed practices can affect the different cultural resources in the Forest in different ways. Cultural resources in El Yunque National Forest can be broadly divided into three major groups: structures, rock

art sites, and archaeological sites (historic and prehistoric). Each of them constitutes a sector with different characteristics and different susceptibilities to adverse effects.

Recreational use of the Forest presents the greatest potential effects on the cultural resources in the Forest. Given that all alternatives presented focus heavily on developing or maintaining a high level of recreation, the principal effect is to be received by the historic recreation infrastructure of the Forest. High levels of visitation signify greater access and use of the resources, which increases wear and tear on the infrastructure, and augments the likelihood of damage by use or vandalism. Activities associated with dispersed recreation can affect cultural resources; particularly trail construction associated with the expansion or alteration of existing historic trails.

Other activities involved in other management practices also present the possibility of having effects on cultural resources. For example, activities associated with watershed restoration could impact existing historic dams, which might be potentially eligible for inclusion in the National Register. Another example is the proposed limited timber extraction. Although El Yunque does not have an active timber extraction program to the scale of other Forests in the mainland, the proposed limited timber demonstration areas (alternative 1) and the proposed "post" harvesting (from Forest products) in the CIRMA (alternatives 2 and 3) could involve activities that cause soil movements, mixing and/or compaction thus having the potential to disturb archaeological sites. Activities such as lowering the maintenance level of existing trails (alternative 3) will have effects on the existing historic trail infrastructure. The increase in the efforts to share historical information as well as the proposed reuse of existing historic infrastructure will also have direct and indirect effects on the resources in the Forest.

An outline of the actions that will have predicted effects on cultural resources is outlined below by alternative. For each alternative the effects of the desired future conditions, management areas, and geographic areas was taken in account (if present on the plan). The desired future conditions section includes the actions that were considered to have the likelihood of having effects on cultural resources. Actions not listed were found to present a very low to non-existent likelihood of effects, and thus were not outlined.

We acknowledge that some of the proposals made are programmatic in nature and do not present enough detailed information with enough definition to properly assess the effects of the individual undertakings. As such they will be assesses on a project-base-level at the moment of implementation. In the case of cultural resources the effects assessment will include NEPA, as well as NHPA consultation.

Alternative 1

New Developed Recreation Sites (Recreation and Facilities and Transportation)

Increase in public access and use of the Forest would have the potential to affect cultural resources. The increase in public visitation increases the potential for vandalism of archaeological sites and historic infrastructure. It also increases decay by wear and tear of actively used historic recreation infrastructure such as trails, observation towers, picnic shelters and access roads. The construction of new developed recreation areas would involve some level of soil movement, which potentially could disturb existing archaeological sites at the chosen development locations. Expansion of existing historical recreation infrastructure could also alter the context of each location altering its integrity and significance.

Environmental Education – Cultural Resources

The proposed educational and interpretative offering, which will "assist visitors and users in understanding… the role of … cultural resources" will have the effect of increasing knowledge and

awareness of the resources. That could have the effect of reducing misuse and vandalism because of increased awareness of the importance of the resource.

Wild and Scenic Rivers and Scenery – Cultural Resources

The proposed management of these areas as restricted development sections will reduce the possibility of undertakings which could disturb cultural resources.

Timber Demonstration – Cultural Resources

Extraction of timber has the potential to involve a variety of activities, which could result in soil movements and direct damage to archaeological resources. Such activities could include but are not limited to yarding, access road creations, soil compaction by machinery or traffic, and soil destabilization.

Management Areas - Cultural Resources

Management Area 1 (Administration sites)

The proposed reconstruction of trails could affect their historic integrity.

Management Area 2 (Developed Recreation)

The development and enhancement of developed recreational activities in this area presents the potential to have direct and indirect effects on existing historic infrastructure and historic properties, which make up the backbone of the recreational offering. Effects of the actions on this area are the same as the ones outlined previously on the "New Developed Recreation Sites" assessment above.

Management Area 3 (Communications Sites)

The proposed removal of communications facilities from the east end of El Yunque Peak Site and the proposed interpretation of the cultural resources there will have the effect of removing the detracting modern infrastructure from the cultural resource enhancing its historical context and user experience.

Management Area 4 (Integrated)

Some research and dispersed recreation activities to take place in this area present the likelihood of potential disturbance to cultural resources if they involve soil movement and by increasing unsupervised access to existing or undiscovered resources in the area.

Management Area 5 (Wilderness)

The preservation of the area as a wilderness limits all development, thus directly reducing direct and indirect effects on present cultural resources. The restrictions on management practices will have the direct effect of reducing the ease of maintenance on the two historic trails existing in the area (Trade Winds and El Toro).

Management Area 6 (Research Management Area)

The potential exists for research projects to disturb archaeological sites or alter the characteristic of existing historic properties if the research activity is to involve soil disturbance and/or installation of research equipment on historic properties.

Management Area 8 (Timber Demonstration)

The timber extraction activities proposed for this area have the same potential effects as the Timber Demonstration desired future condition.

Management Area 9 (Scenic Rivers and Scenery Resources)

The proposed management of these areas as restricted development sections will reduce the possibility of undertakings, which could disturb cultural resources.

Alternative 2

Socioeconomics - Cultural Resources

The economic opportunities provided to the community, such as guided excursions and outfitting opportunities, have the potential to increase visitation to cultural resources, such as scenic areas with petroglyphs, enhancing educational opportunities. Increasing unsupervised visitation and encounters with archaeological sites could lead to looting and damage to resources. Partnerships with the community have the potential effect of increasing site condition monitoring opportunities.

Environmental Education - Cultural Resources

The development of interpretative and educational efforts can have a direct, indirect, and cumulative effect on the preservation of historic properties by increasing awareness of their importance in the public's mind, potentially reducing misuse and vandalism.

New Developed Recreation - Cultural Resources

Developing recreational opportunities in the lower part of the Forest will have the effect of reducing the strain on the existing historic recreational infrastructure located on the upper part of the Forest (PR Road 191 Corridor). The development of new recreation areas in the lower parts could have a direct impact on already discovered or undiscovered historic and archaeological resources if the development includes soil movements. A long-term cumulative effect and indirect effect could result if the newly developed recreation opportunities grant access to archaeological and historic resources by means of developed recreation areas such as parking lots, picnic areas and trails. This might cause an increase in opportunities of unsupervised access to the resources, which could lead to looting, vandalism, and/or damage.

Actions on reducing the backlog of maintenance of existing recreational historic infrastructure will have a direct effect of improving the historic properties condition. The increase in historic literacy that will result from the development of the proposed historic/cultural recreation opportunity guides will have the potential effect of increasing awareness on the importance of heritage resources.

Forest Products - Cultural Resources

The extraction of Forest products within the CIRMA could have a direct effect on archaeological/historic resources if the extraction of such resources would include any kind of soil movements such as those created during the construction of new access roads, timber yarding, planting and harvesting areas, etc.

Facilities and Transportation - Cultural Resources

The proposed creation of timber extraction roads has the potential to disturb existing archaeological sites. The proposed private investment opportunities on abandoned historical facilities as well as the proposed annual maintenance inspections are likely to have an effect on the enhancement of the condition of the historic infrastructure.

Management Areas - Cultural Resources

Management Area 2 (El Yunque Zone)

The restoration and management of recreation infrastructure in these areas will have a direct effect of maintaining/preserving existing historic infrastructure, which is the backbone of the infrastructural

recreational offering. The interpretation of the cultural resources in that area could have a direct and cumulative effect of reducing damaging practices by the public such as vandalism. The increase in visitation to the resources in that area could have the indirect effect of increasing vandalism and wear and tear on the historic infrastructure.

Management Area 3 (Communications)

The proposed removal of communications facilities from the east end of El Yunque Peak Site will have the effect of removing the detracting modern infrastructure from the cultural resources located at El Yunque Peak. The proposed interpretation of the cultural resources there will directly enhance its historical context and the public understanding.

Management Area 4 (CIRMA)

The increase in access of the community to this land will have the effect of increasing access to cultural resources in this area. That could develop into greater vandalism and looting of existing or still undiscovered cultural resources in that area. The use of the area for dispersed recreation could reduce the effects that the high visitation has on the cultural resources located on the upper part of the Forest. The shared stewardship of this area could have the direct effect of increasing stewardship and shared stewardship opportunities of the cultural resources in the area and can increase educational opportunities. Resource extraction activities proposed for this area have the direct or indirect potential of disturbing cultural resources if they involve the creation of roads, soil movement, or other practices similar to the ones outlined on the desired future conditions section for CIRMA.

Management Area 5 (El Toro Wilderness)

The preservation of the area as a wilderness would limit all development, thus directly reducing direct and indirect effects on existing cultural resources. The restrictions it imposes on management practices will have the direct effect of reducing the ease of maintenance on the two historic trails existing in the area (Trade Winds and El Toro).

Management Area 6 (Research)

The potential exists for research projects to disturb archaeological sites or alter the characteristic of existing historic properties if the research activity is to involve soil disturbance and/or installation of research equipment on historic properties.

Management Area 7 (Research Natural Area)

The use of this area for non-manipulative studies only will have the indirect effect of restricting recreational use and discouraging public traffic, and reduces the likelihood of invasive research. All this has the direct effect of reducing the likelihood of disturbance to cultural resources in the area.

Management Area 9 (Scenic Byway 186)

The proposed creation of the Scenic Byway Management Area as outlined will require a higher level of maintenance, stewardship, and interpretation of the historic sites along the route. The increase in maintenance and interpretation will help improve and monitor the conditions of the resources, which have been neglected to a greater degree than similar resources along PR Road 191. This will have an effect on the resource by increasing public awareness of the resources importance, and has the potential to increase visitation to a number of historic structures along the route. The increase in visitation on the area might increase the likelihood of vandalism on the sites. It will also have the accumulative effect of wear and tear on the sporadically used historic road, bridges and related features.

Geographic Areas - Cultural Resources

North and Southwest Geographic Areas

The proposed increased interconnection of existing trail to points of access within the municipalities will likely have the indirect effect of increasing accessibility to the Forest and its cultural resources. This could translate into increased use of the newly accessible areas, augmenting the likelihood of wear and tear on the existing historic trails, and increasing the potential of unauthorized activities such as vandalism and looting. The proposed development of collaborative efforts with the community for increasing collaboration, conservation, and interpretation initiatives will potentially have the indirect effect of increasing educational and interpretative opportunities to increase education about the cultural resources in the Forest. The increase in collaboration might directly affect the conservation and study of cultural resources by increasing research, funding, and partnerships towards that goal.

Alternative 3

The effect of the resources desired conditions are the same as in alternative 2, but it adds the following.

Extension of Wilderness to Research Natural Area - Cultural Resources

The recommended extension of the wilderness area to encompass the Baño de Oro Research Natural Area would potentially have the effect of reducing the probability of site disturbances due to the highly regulated practices and activities allowed on wilderness reserves.

Facilities and Transportation - Cultural Resources

The proposed change of trail care level to maintenance levels will have an effect on the maintenance of the many of the historic trails. The reduction of maintenance will affect the conservation of the historic trail system and its potential interpretative use.

Management Areas - Cultural Resources

Management Area 2 (El Yunque Zone)

The restoration and management of recreation infrastructure in those areas will have a direct effect of maintaining preserving existing historic infrastructure, which is the backbone of the infrastructural recreational offering. The interpretation of the cultural resources in that area could have the effect of reducing damaging practices by the public such as vandalism. The increase in visitation to the resources in that area could have the indirect effect of increasing vandalism and wear and tear on the historic infrastructure.

Management Area 3 (Communications)

The proposed removal of communications facilities from the east end of El Yunque Peak Site will have a direct effect of removing the detracting modern infrastructure from the cultural resources located at El Yunque Peak. The proposed interpretation of the cultural resources there will directly enhance its historical context and the public understanding.

Management Area 4 (CIRMA)

The increase in access by the community to this land will have the direct effect of increasing access to cultural resources in this area. That could result in greater vandalism and looting of existing or still undiscovered cultural resources in that area. The use of the area for dispersed recreation could reduce the effects that the high visitation has on the cultural resources located on the upper part of the Forest. Shared stewardship of this area could have the effect of increasing educational and cultural resources opportunities. Resource extraction activities proposed for this area have the potential of disturbing

cultural resources if they involve the creation of roads, soil movement, or other practices similar to the ones outlined on the desired future conditions section for CIRMA.

Management Area 5 (El Toro Wilderness)

The preservation of the area as a wilderness section will limit all development, thus directly reducing direct and indirect effects on present cultural resources. The restrictions it imposes on management practices will have the direct effect of reducing the ease of maintenance on the two historic trails existing in the area (Trade Winds and El Toro).

Management Area 6 (Research)

The potential exists for research projects to disturb archaeological sites or alter the characteristic of existing historic properties if the research activity is to involve soil disturbance and/or installation of research equipment on historic properties.

Management Area 7 (Baño de Oro Proposed Wilderness)

The extension of the wilderness area into the 629-acre section of the research natural area will extend the protections and restrictions of wilderness management to this area. This will have the effect of limiting all development in the designated section, reducing direct and indirect effects to the cultural resources present. The restrictions it imposes on management practices will have the direct effect of reducing the ease of maintenance and monitoring of existing resources in the area.

Geographic Areas - Cultural Resources

North and South Geographic Areas

The proposed increase in interconnection of existing trail to points of access within the municipalities will likely have the direct effect of increasing accessibility to the Forest and its cultural resources. This could translate in increased use of the newly accessible areas, increasing the likelihood of wear and tear on the existing historic trails and increasing the potential of unauthorized activities such as vandalism and looting. The proposed development of collaborative efforts with the community for increasing collaboration, conservation, and interpretation initiatives will potentially have the indirect effect of increasing educational and interpretative opportunities involving the cultural resources in the Forest. The increase in collaboration might directly affect the conservation and study of cultural resources by increasing research, funding, and partnerships towards that goal.

3.5.5 Recreation

This analysis focuses on recreation sustainability and issues related to visitor use, capacity, and recreation infrastructure (parking limitations, structures, maintenance and demand) and recreation impacts to resources. For the cumulative effects analysis, the following activities and plans that occur on the private land/Forest interface were considered including the east, west and southwestern regions. Foreseeable actions include the development of a regional trail with municipalities and a non-profit partner that would connect the Forest to the coast, and a state proposal for a scenic byway on the western side of the Forest. Ongoing activities include community use located adjacent to the Forest interface areas. The timeframe is the life of the plan (approximately 15 years).

3.5.5.1 Affected Environment

Visitor Use and Recreation Settings

Covering approximately 29,000 acres, El Yunque is the only tropical rain forest in the National Forest System, boasting unique and breathtaking views, biodiversity, and a variety of outdoor recreational

opportunities. It is a favorite recreation destination for both locals and the many tourists who visit Puerto Rico from around the world. The Forest receives over 650,000 visitors per year (Buta et al. 2014). These visitors make over 1.2 million site visits making it one of the most heavily visited Forests per acre in the National Forest System. This means that most Forest visitors visit more than one Forest destination during their visit. The major recreation areas (picnic areas and trails, observation tower, pools and bathhouses) are located along the main access road PR-191, which was built in the 1930s by the Civil Conservation Corps (CCC). Many of these structures and facilities are still in use today.

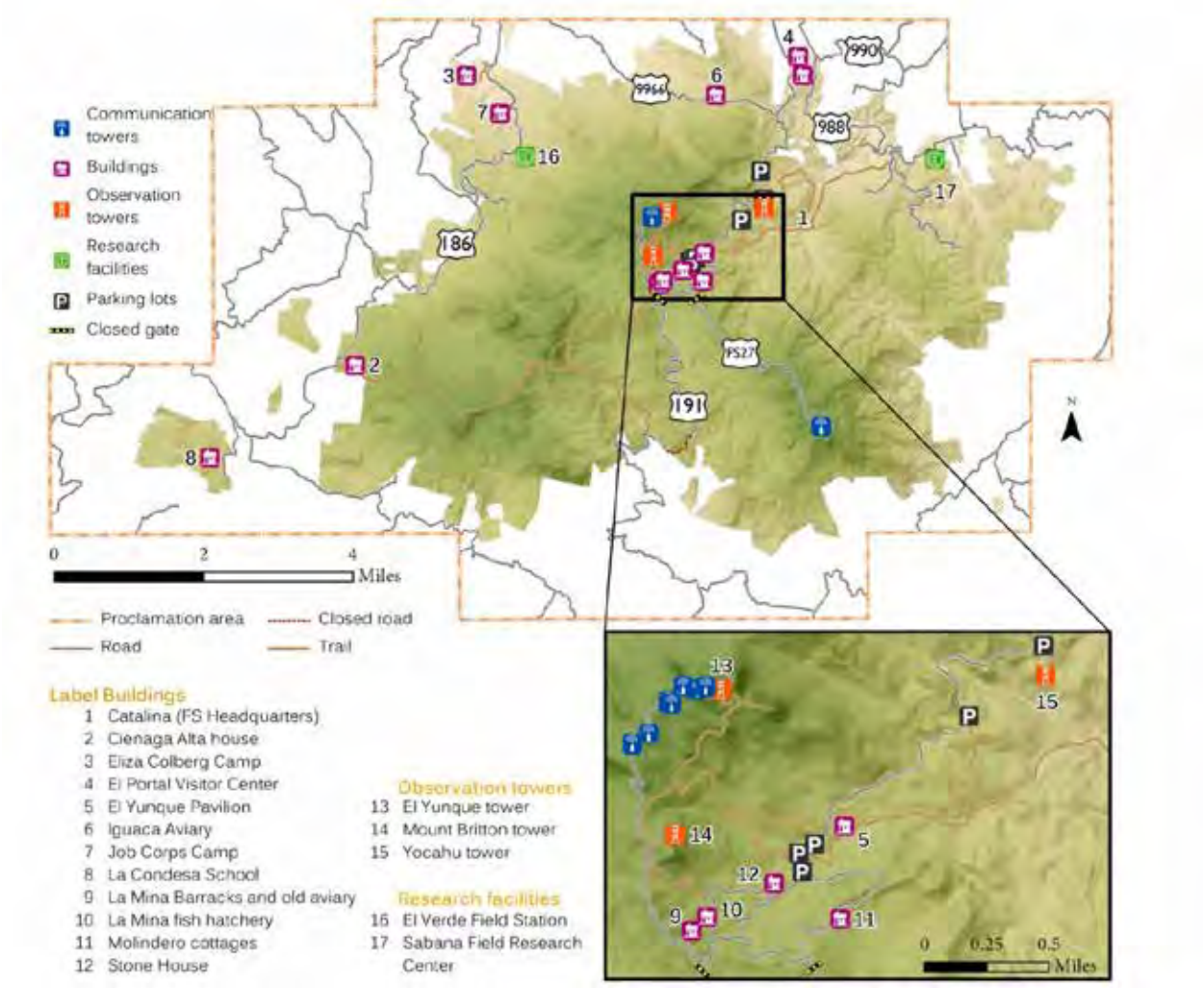
Recreation use occurs year-round due to the warm tropical climate. Use by local visitors is greater during the summer months, while more international visitors come during the winter months. The total number of visitors is approximately evenly divided between local residents and off-Island tourists. The types of recreation activities in the Forest has not changed drastically throughout the years. Visitors continue to enjoy hiking along trails, using the picnic areas, stopping at vista points and at the observation towers, photographing nature, and cooling off in the river and streams.

The recreation opportunity spectrum (ROS) is used to identify recreation activities throughout a Forest. The recreation opportunity spectrum provides a framework for Forest administrators to manage and for users to enjoy a variety of recreation environments. The ROS is used to determine if projects are compatible with Forest recreation goals. At the project level, this framework is used to determine if a project is moving toward or away from the desired ROS. In many cases, change to the transportation system can have the biggest impact on ROS.

The ROS classes in El Yunque range from “semi primitive non-motorized” to “rural” settings. El Yunque has 21 active recreation sites that include a high capacity visitor center, 4 picnic areas totaling 51 picnic shelters, 12 observation sites, and 8.7 miles of trails. Recreational opportunities based on available recreation sites at El Yunque include hiking, backpacking, primitive camping, water play, picnicking, scenic driving, nature viewing, viewing cultural resources, photography, birdwatching, outdoor learning and nature study.

El Yunque has four access routes that run through the Forest; PR-191, PR-988, PR-9966, and PR-186. Recreational opportunities on PR-988, PR-9966, and PR-186 are currently limited due to available development, available personnel, road conditions, and limited use; making PR-191 an 8.1-mile, two lane road with no throughway, the primary recreation opportunity corridor. Despite a proportionally high level of concentrated development along PR-191, developed recreation sites do not meet the demand during high visitation periods.

Despite the level of development along the PR-191 corridor (map 3-19), El Yunque is challenged to fully provide recreational opportunities. New vehicle limits on the highly popular PR-191 corridor are monitored by vehicle counters, allowing management the tools necessary to manage and regulate the maximum number of visitors in the corridor at one time and thus reduce some of the impacts associated with “extremely high” and “excessive” use. This management, however, comes at the cost of lost recreational opportunities to visitors who are not able to enter the PR-191 Corridor. While PR-186, PR-191 south, PR-988, and PR-9966 provide access to other locations in the Forest, road conditions and lack of public knowledge deter users from visiting these other locations. While potential and demand to develop additional recreational opportunities along state roads in El Yunque exist, current limitations to funding levels and adequate personnel prohibit increased development. These needs to account for both capital improvement costs along with the additional operation and maintenance costs associated with additional developed recreation sites.



Map 3-19. El Yunque National Forest infrastructure and vegetation

Recreation Infrastructure

Forest visitors visit several destinations during their time on the Forest. Recreation on the Forest has been ongoing since the first facilities were constructed during the CCC period in the 1930s. Most of these facilities are still in use. Several facilities have been improved to meet current sanitary and accessibility standards and to increase parking capacity by redesigning parking areas and creating overflow parking spaces. These include Yokahu Tower, Palma de Sierra Picnic Area, and Palo Colorado Picnic Area. Forest vegetation density and steep topography greatly limit expansion of existing facilities as well as the development of new facilities.

There are two recreation sites along PR-988 which are mostly used by neighboring communities; these are Puente Roto and Angelito Trail. Puente Roto is mostly used on weekends and holidays and has parking issues and trash problems. The Rio Mameyes was designated as a wild and scenic river which require special protection and management. Angelito Trail is a short trail that leads to Rio Mameyes, a favorite local water play area. Parking in this area has been a concern due to several car collision incidents. See the Recreation Specialist Report for additional information on recreation sites and infrastructure.

State road PR-186 crosses through the western portion of El Yunque, traveling through a mixture of Forest and urban settings. Portions of this road have a number of scenic views and waterfalls; however, poor road conditions and lack of knowledge prevent Forest visitors from recreating on this portion of the Forest. Mostly locals recreate at the various river crossings that occur along this road.

Recreational opportunities are fairly limited. Currently, both El Toro Trailhead and Quebrada Grande Picnic Area are closed. El Toro Trail #34, a 2.2-mile trail crossing through El Toro Wilderness, is in need of repairs to address major drainage problems. Quebrada Grande Picnic Area is currently closed due to low us and poor road conditions in the area.

The high use of trails, especially the trails that do not have a built-hard surface, have eroded the trail surface causing erosion problems on the trail surface itself. In some cases the actual trail has become the main drainage-way. The picnic shelters also receive high use which require high maintenance for sanitary reasons and graffiti. See the Recreation Specialist Report for additional information on recreation infrastructure.

Recreation-related infrastructure suffered significant damage after hurricanes Irma and María, including landslides or bed failures on trails, damaged picnic shelters, and damage to recreation-related historic infrastructure. The collapse of the infrastructure also had severe impacts on the recreation offering and socioeconomic opportunities provided by the forest including lack of access for tourism, telecommunications and research.

Recreation Capacity

In 2011, capacity along PR-191 was set at 300 vehicles, based on 274 available parking spaces and approximately 26 parking spaces at private in-holding stores and restaurants along PR-191. Available parking at El Portal was evaluated separately because it is a recreation fee site.

Based on a 100 percent capacity of 300 vehicles, use classes were set as 33, 66, 100, 133, 166, and 200 percent plus, from low to excessive, using road counter data from PR-191 during portions of 2014 and 2015. The percentage of each use type was also computed based on counter data. In addition, the number of visitors in the Forest was approximated using an estimate of 2.5 visitors per vehicle. The results of this exercise are shown on table 3-44.

Table 3-44. Approximate vehicles and users per level of use

El Yunque Approximate Vehicles and Users Per Level of Use	Low (0–100)	Mod (101–200)	High (200–300)	Very high (300–400)	Extreme (400–500)	Excessive (500+)
Percent of use type per year	4%	15.0%	31.0%	30.0%	13.5%	7.0%
Number of vehicles in Forest	100	200	300	400	500	600
Percent of total capacity	33%	66%	100%	133%	166%	200%+
Vehicles seeking parking	0	0	40	140	240	340+
Total vehicles/day	300	500	700	900	1,100	1400
Total users/day (2.5/vehicle)	750	1,250	1,750	2,250	2,750	3500
Number of users in Forest (2.5/vehicle)	250	500	750	1,000	1,250	1500

'Number of vehicles in forest' and 'Number of users in forest' show an estimate of the number of users in the PR Road 191 corridor during a given use level while 'Total vehicles per day' and 'Total users per day' show an estimate of the total users per day during a given use level.

Currently, developed recreation sites along PR-191 routinely receive very high (133 percent capacity) to excessive (200 percent capacity) use throughout the season, with a long recreational season that starts in November and continues into the new year to August, providing the Forest only two truly moderate use months (September and October). Highest use months are March, July, and December.

Table 3-45 and figure 3-12 show "extreme" and "excessive" use during the July and August 2014 busy season. Table 3-46 and figure 3-12 show "very high" and "extreme" use during the March and April 2015 busy season. Daily total visits track the total number of visits during a given day, while daily max tracks the maximum number of vehicles in the Forest at any one time. The sudden drop in use in early August is due to extreme weather.

Capacity issues are mostly concentrated at Big Tree Trail, La Mina Falls, and Palo Colorado Picnic Areas. Big Tree Trail and Palo Colorado Picnic Areas provide the main access route to La Mina Falls. Additional details are located in the Recreation Specialist Report. This heavy concentration of people and vehicles have an impact on the resource. There are designated parking areas as well as overflow parking, but once these areas are full, people start parking their vehicles anywhere they find an open space along PR-191.

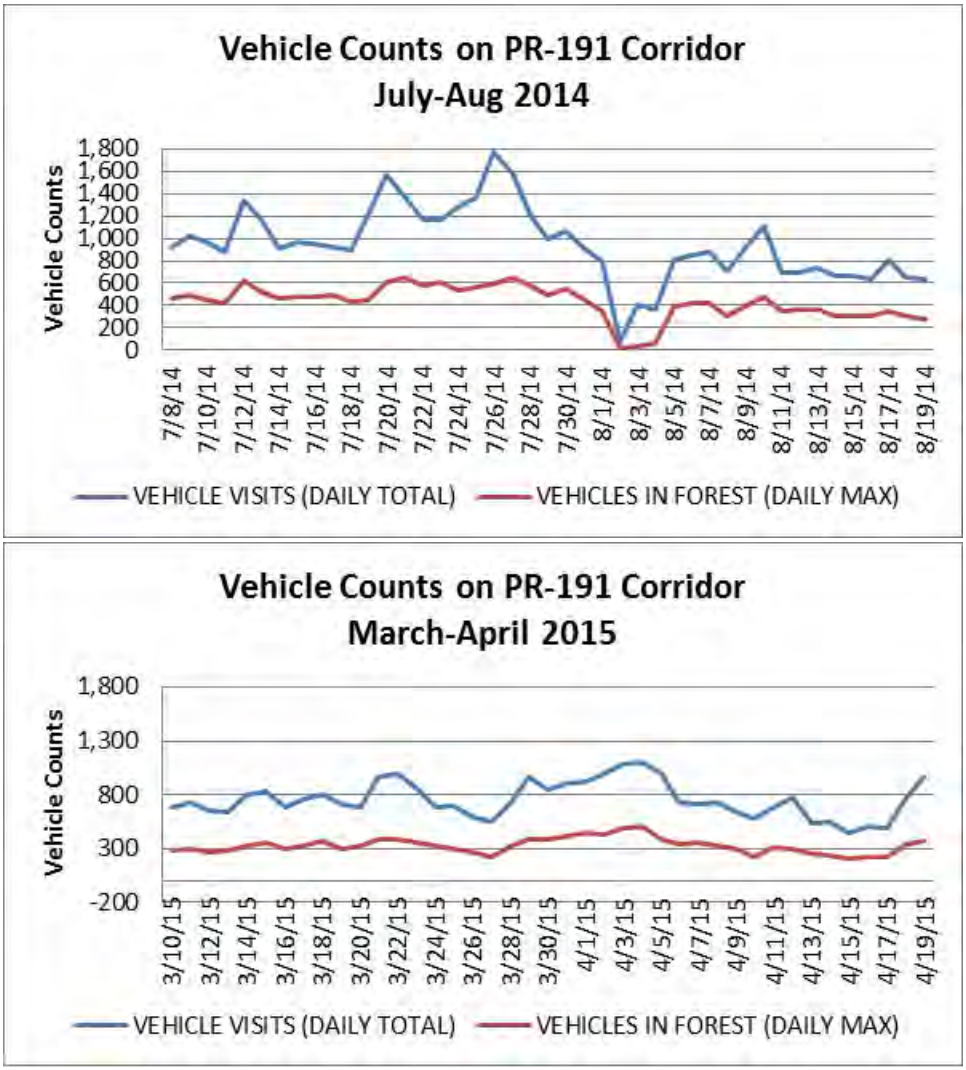


Figure 3-12. Vehicle use counts on PR Road 191 corridor

This uncontrolled parking impacts vegetation and natural drainages. Vehicles often get stuck and require towing. Another impact from high visitation is the amount of trash generated. Trash is piled next to trash cans once they are full and some of that trash ends up along the trails and in Rio de la Mina, a wild and scenic river. Outfitters and guides are also a part of the capacity issue. They continue their normal operations regardless of the high visitation and traffic congestion. Some outfitters will drop their customers off at one of the two La Mina Falls access trails and pick them up at the other trail where they exit the falls. Tour buses average about 20 to 25 persons.

The Forest Interpretive Association is providing visitor services at El Portal and Palo Colorado Picnic Area. The Association also has store outlets at La Coca Falls and Yokahu Tower providing limited customer service. The food concessionaire provides some visitor service information at Big Tree Trailhead, Palo Colorado, and Palma de Sierra Picnic Areas. El Yunque's Park Rangers provide partners with visitor information training annually.

The capacity issue at La Mina Falls has made outfitters and Forest visitors seek other water venues in the Forest. Juan Diego Creek has recently become an option for people seeking a stream with a waterfall. Juan Diego Creek is near Big Tree Trail parking areas making it easy for people to walk along the road to reach the creek. The increase in visitation to this area has caused sever erosion problems along the paths that lead to the falls. Once there, some visitors have opened a new path to get to the upper portions of the creek, causing erosion problems. The Juan Diego Creek area is a small area which is being overused and is being negatively impacted by high visitation.

To address current capacity issues, the Forest has implemented traffic control operation (TCO) during high visitation periods (spring break and June and July). The TCO consists of placing Forest personnel at strategic recreation sites to monitor parking and traffic flow. Currently the state police, in cooperation with Forest personnel, assist during TCO. When all available parking areas are full a Forest closure is implemented at the La Coca Falls gate. The tram system is still being evaluated to determine the best activation periods and routes to be used. Traffic control operation staffing and funding has had an impact on the Forest due to the fact that high visitation mostly occurs on weekends and holidays.

Despite the high level of development on the PR-191 North Corridor, ongoing very high to excessive levels of use are taxing the existing infrastructure. Impacts from high visitation are varied both in type and duration. Types of impacts during "very high" to "excessive" use could include increased health and safety risks, impacts to trail resources, and social encounters.

During "very high" to "excessive" levels of use, risks to public health and safety increase due to the number of visitors on the road, high levels of traffic, limited restrooms, and longer emergency response times. Use levels are highly variable through the day as use increases and decreases and tend to peak between 10:00 a.m. and 2:00 p.m. during high visitation periods. The risk to public safety is particularly pronounced during extremely high to excessive use, when an alarmingly high number of vehicles and visitors are packed in a relatively small stretch of road with limited parking, leading to high a number of vehicles parking in non-designated spots, large crowds congregating in roads, extreme to excessive numbers of visitors overwhelming public restroom facilities, and a practical standstill of vehicular traffic, resulting in extended emergency vehicle response times. These increased risks, however, are short term and cease once the use levels are reduced, with the exception of health and sanitation impacts, which manifest in the form of urine smell around structures such as picnic and rain shelters, and can linger until major rain events.

Impacts to trails also increase during periods of very high to excessive use, when even the high level of trail development is not sufficient to reduce visitor impacts as crowds begin to pass each other on the trail shoulder, producing soil compaction, killing vegetation, and in essence widening the trail. These

increased impacts are cumulative over time as the vegetation's resiliency is effectively reduced due to ongoing trampling during repeated and prolonged periods of "very high" to "excessive" use.

Another impact along trails during periods of "very high" to "excessive" use is the number of social encounters. While a large number of facilities and trails fall under an "urban" ROS setting, which defines the level of social encounters as "Large numbers of users on site and in nearby areas" and "High number of social encounters," one could easily argue that during periods of "extremely high" and "excessive" use, one could encounter such large crowds that would exceed even the "urban" setting. This is particularly pronounced around observation points where large crowds can block access and or views. For areas with ROS settings below "urban," ROS settings would increase to "urban" during periods of "very high" to "excessive" due to the large number of encounters, regardless of the physical setting.

Figure 3-12 shows the daily use patterns for PR Road 191 during a week in July. These daily patterns show that demand increases in the morning, peaks in the afternoon, and drops in the evening. During the busy months, use can reach "high" (67 to 100 percent) capacity as early as 9:00 a.m., "very high" (101 to 133 percent) by 9:30 a.m., "extremely high" (134 to 166 percent) by 10:00 a.m., and "excessive" (167 to 200 percent) by 11:00 a.m. "Excessive" use can last as long as 3:30 p.m.; with use patterns dropping to high by around 5:00 p.m. Such a high level of use has forced the Forest to close access at approximately 450 to 500 vehicles due to the increased risk to public health and safety along with correlated trail widening during "extreme" and "excessive" use where people use more width than the trail has. Forest closures due to "extreme" and "excessive" use can be seen in the daily use patterns for Thursday, Friday, Saturday, and Sunday as a temporary steep drop in use. There is a second increase in use as the Forest is opened to the public again. The Forest is still fine-tuning the counter system to provide better real-time data so they can better manage use in the Forest.

Existing Recreation Sites in El Yunque

Forest access routes through the Forest include four state roads: PR Road 191 North, PR Road 191 South, PR Road 988, PR Road 9966, and PR Road 186. These access state roads vary in condition and level of amenities provided. Currently, the majority of the recreation infrastructure is centered on the north portion of PR Road 191 North, a limited 8.1-mile road with no throughway. Developed recreation is analyzed based on access routes.

Recreation Sites on PR Road 191 North

PR Road 191 is unique in that it runs through the center of El Yunque, providing intimate access to an otherwise highly inaccessible landscape. A landslide in the mid-1970s closed portions of PR Road 191 to the public. Use on PR Road 191 North is currently an 8.1-mile loop road. This means that vehicle traffic enters and exits this area of the Forest along the same road.

A total of 20 recreation sites range in recreation opportunity spectrum class from "roaded natural" to "urban." The primary route through EL Yunque provides a high level of developed recreational opportunities in this area. There is a visitor center, an information roadside kiosk, 6 roadside observation sites, 3 picnic areas with a total of 41 picnic shelters, 5 trailheads serving 8.3 miles of trail connecting to an additional 7 observation sites and the recreation portion of the La Mina Wild and Scenic River, all along 8.1 miles of road through a tropical forest ecosystem. In addition, private inholdings along PR Road 191 North also provide a number of additional services ranging from novelty shops to food services (table 3-39).

Table 3-45 shows an estimate of the number of users wanting to use a particular trail system during "low," "moderate," "high," "very high," "extreme" and "excessive" use periods. Table 3-46 shows an estimate of the total number of users that may use a particular trail system per day during these same periods. (That

is, table 3-45 shows real-time demand while table 3-46 shows total daily use). These tables show the magnitude of use during "very high" to "excessive" use; and also the percent of the year that the trail systems endure given use levels. Note that trails receive above maximum capacity (from "very high" to "excessive") 50.5 percent of the time. For perspective, during excessive use levels there may be approximately 750 visitors at La Mina Falls Trail System and as many as 1,750 visits in a day. During periods of "extremely high" to "excessive" use, some visitors will not be able to see La Mina Falls due to the large crowds.

Note that on table 3-45 and table 3-46, use is distributed based on parking availability as a percentage of total parking and is meant as general reference. While this table represents potential use based on available parking, La Mina Falls is incredibly popular, and may actually draw some use away from El Yunque Trail system parking areas. La Coca Trail was not included in the Forest trail system because of its low use, challenging conditions, and limited parking spaces (four each).

Table 3-45. Demand per trail system based on total visitors during low through excessive use

	Parking	Miles	Low (0–100)	Mod (101–200)	High (200–300)	Very High (300–400)	Extreme (400–500)	Excessive (500+)
La Mina Falls Trail System	101	1.6	125	250	375	500	625	750
El Yunque Trail System	77	3.8	95	190	285	380	475	570
Mt. Britton Trail System	24	1.1	30	60	90	120	150	180
# of Users In Forest	202	6.5	250	500	750	1,000	1,250	1,500
# of Vehicles In Forest			100	200	300	400	500	600
Percent of Use Type/Year			4.0%	15.0%	31.0%	30.0%	13.5%	7.0%
Risk to Public Health and Safety			L	L	L	M	H	VH
Resource Damage			L	L	L	M	H	VH
Social Encounters			L	M	M	H	VH	VH

Table 3-46. Total daily visitors per trail system (based on total use per day)

	Parking	Miles	Low (0–100)	Mod (101–200)	High (200–300)	Very High (300–400)	Extreme (400–500)	Excessive (500+)
La Mina Falls Trail System	101	1.6	375	625	875	1,125	1,375	1,750
El Yunque Trail System	77	3.8	285	475	665	855	1,045	1,330
Mt. Britton Trail System	24	1.1	90	150	210	270	330	420
Total # of Users/Day	202	6.5	750	1,250	1,750	2,250	2,750	3,500
Total # of Vehicles/ Day			300	500	700	900	1,100	1,400
% of Use Type/Year			4.0%	15.0%	31.0%	30.0%	13.5%	7.0%
Risk to Public Health and Safety			L	L	L	M	H	VH
Resource Damage			L	L	L	M	H	VH
Social Encounters			L	M	M	H	VH	VH

Table 3-46 shows an estimate of the total number of users that may use a particular trail system per day during these same periods. (That is, table 3-45 shows real-time demand while table 3-46 shows total daily use).Note that on table 3-45 and table 3-46The alternatives presented focus on managing recreation in different Forest settings and circumstances. They provide direction on how to manage recreation activity in designated wilderness areas and wild and scenic rivers (alternative 1). Alternatives also address the impacts related to high concentrated visitation and finding new recreation alternatives outside the PR-191 corridor (alternatives 2 and 3).

The actions that will affect recreation are outlined by alternative. The desired conditions, management areas, and geographic areas were the major topics evaluated in each alternative. In the desired conditions section only the actions directly related to recreation were evaluated. The same applies for management and geographic areas.

3.5.5.2 Environmental Consequences

Effects Common to all Alternatives

All alternatives continue to offer recreation along the PR 191, resulting in continued need to address capacity on PR 191 and infrastructure maintenance for this corridor. This is a direct effect of using PR 191 as a recreation area in the Forest. All alternatives offer the same forms of recreational opportunities, which would continue to affect the resources that are utilized for these types of recreation. For example,

water play would continue within the Forest, resulting in a need to monitor water quantity and quality as well as climate change effects.

Alternative 1

This alternative follows the 1997 Forest Plan direction which does not include a component that addresses sustainable recreation. This Plan calls for an increase in recreation opportunities to meet current and future demands regardless of impacts to the resource. There is limited direction to address the impacts that recreation site development will have on Forest infrastructure and capacity.

Under the current plan, there would continue to be impacts to existing recreation facilities with the increased use and high visitation. The deterioration of trails due to high use would continue to create safety issues. The cumulative effects of having more recreation development will detract from having a quality experience in the rain forest, due to how it impacts the natural settings of the Forest; not to mention the amount of impact it will have on other resources. The impact of climate change with relation to recreation is not addressed in this alternative. The social and economic issue related to recreation would continue to provide options to local businesses and outfitters and guides.

Recreation Sites

The needs of Forest visitors are met with services and facilities. Opportunities and facilities for a wide variety of recreation experiences are met. Recreation demands are prioritized over impact to facilities and capacity issues. Trails systems focus on experience, ecosystems, difficulties, and length. Protection of the trail systems is not addressed. Recreation activity continues to be concentrated in the main PR-191 Corridor, because it does not offer recreation in other areas of the Forest.

Wild and Scenic Rivers - Recreation

Recreation segments of designated wild and scenic rivers allow for picnic area and trail construction in close proximity to the river. This type of development would increase the amount of trash near the rivers.

Law Enforcement - Recreation

Parking and traffic management and uniformed Forest Service personnel are used at times and locations of heavy public use. The increase in Forest visitation requires new and updated methods to deal with high visitation.

Environmental Education - Recreation

The capacity for offering environmental education would continue to be reduced because this alternative does not offer environmental education under collaborative considerations. The program would continue to be oriented toward learning about the resource and not about protecting the resource or learning about impacts related to carrying capacity issues.

Management Areas - Recreation

Management Area 1 (Administrative sites)

The recreation components in this management area are located at the lower levels of the Forest where building enhancement has occurred with the construction of El Portal Visitor Center. The plan would allow for additional recreation development that may not be considering current visitor capacity levels, available facilities, parking and fiscal reality on the Forest.

Management Area 2 (Developed Recreation)

Management Area 2 direction provides for the construction of new developed recreation facilities, but does not address protection of the resources. The construction of new facilities could adversely affect the natural resources found in the PR-191 Corridor. This could also result in the unsustainable use of Forest ecological and infrastructure resources when considering climate change tendencies that can range from severe droughts (summer and fall 2015) to heavy rain events and flashfloods (resulting in landslides).

Management Area 3 (Communication Sites)

Improving vista point at El Yunque Peak Observation Tower would provide hikers with an undisturbed panoramic view of the Forest and the Atlantic Ocean coastline. There is limited conflict between recreation facilities and the communication sites and structures. The recreation opportunity spectrum setting changes from "semi-primitive non-motorized" along the hiking trails to "semi-primitive motorized" along the roads that service the communication sites, yet this as stated in this alternative does not propose a recreational alignment.

Management Area 4 (Integrated)

Management area 4 would continue to be managed for recreation opportunity spectrum class "roaded natural undeveloped" near open roads and "semi-primitive non-motorized" which provides for a natural recreation setting. This management area does not include collaboration as an option with neighboring communities to better protect resources and to offer other uses within this management area; limiting socioeconomic development in these areas. No dispersed recreation is included to alleviate capacity issues on the PR-191 Corridor.

Management Area 5 (Wilderness)

Maximum encounters and group sizes need to be revised to address the protection of the resource; considering that wilderness designated areas have standards in respects to human encounters. There is a trail that goes from east to west. The current group size is causing damage to the vegetation along the trail and increasing the number of social trails particularly during wet weather conditions.

Management Area 6 (Research)

Continues to limit recreation use in this area due to its location and lack of infrastructure

Management Area 7 (Research Natural Area)

Continues to allow recreation activity in the periphery of the management area. The area does not have an recreation opportunity spectrum class assignment.

Management Area 8 (Timber Demonstration)

This management area should not have an ROS class assignment for safety and health reasons.

Management Area 9 (Scenic and Recreation River Corridor)

Continue to manage the recreation segments of Rio de la Mina and Rio Mameyes. The proposed development of a picnic area near the crossing of the Rio Mameyes and PR-988 (Puente Roto) would increase recreation activity increasing trash along and near a wild and scenic river. There will also be an impact on the natural setting and create additional rive access points.

Alternative 2

This alternative addresses the issue of sustainable recreation and the protection of the resource. Plan direction would limit recreation activities in sensitive areas of the Forest. It would allow at the project level for alternative recreation sites to be identified/constructed at lower forest elevations. The creation of

the community interface resource management area (CIRMA) would provide for engagement with community groups to help manage and maintain recreation areas at the lower elevations near their communities. Capacity issues would be addressed and managed in a way that the resource is protected and the visitor becomes more involved in helping with trash management.

Alternative 2 addresses recreation capacity, the protection of the resource (wetlands), and identifying alternative recreation sites and activities in the lower elevations of the Forest located in the CIRMA and the development of an alternative scenic byway for vehicular recreation. A scenic byway and its further development from state and Federal agencies could create other recreation opportunities within the Forest and disperse these activities off of PR 191, reducing the pressure on sensitive species located on the PR 191 and its recreation sites. Recreation opportunities are in harmony with preserving and conserving the Forest ecosystems on both the PR-191 corridor and at lower elevations. The main recreation focus is to promote long-term ecological, cultural and historical, social, economic sustainability. The Forest carrying capacity is addressed along the PR-191 corridor for the sake of improving the recreation experience and at the same time protecting the resource. Existing facilities and trails located at remote sites at lower elevations are evaluated and co-management is pursued with neighboring community groups. Present and future recreation demands are balanced with the ability of the land to sustain use, the capacity of the Forest staff to manage its use, and the resource available to manage recreation opportunity. The management of trash along recreation segments of wild and scenic rivers and at other undeveloped recreation sites is done by getting Forest visitors to practice "Leave No Trace" and "Pack-it-in and Pack-it-out."

Functional Wetlands - Recreation

The protection and preservation of the functional wetlands could limit the types of recreation activities that occur within this elevation (above 600 meters).

Socioeconomic Resources - Recreation

Provides for recreation opportunities at lower elevations which better connect neighboring communities with the Forest and could decrease saturation and uses of PR 191.

Environmental Education - Recreation

Increased knowledge and collaboration in recreation management with neighboring communities.

Special Uses - Recreation

The role that El Yunque holds as a tourist and recreation destination for locals and visitors that come to Puerto Rico must be closely monitored in relation to sustainability and protecting the resource.

Cultural Resources - Recreation

The reuse of historic properties near recreation sites will make the visitor more aware of the Forest heritage program and give them a feeling of ownership and pride for what the Forest means to Puerto Rico.

Facilities and Transportation - Recreation

A Forest transportation system to facilitate the public's access to the Forest during high visitation periods would be a safer alternative but could cause an inconvenience to those wishing to visit recreation sites on their own. The proposed scenic byway would increase the enjoyment opportunities and help disperse vehicular traffic from visitors that mainly want to have a leisure drive through the Forest.

Management Areas - Recreation

Management Area 2 (El Yunque Recreation Zone)

This zone includes all the recreation areas located along PR-191. The management of this zone will focus on capacity and sustainability issues as well as on the protection of the resource.

Management Area 3 (Communications and Recreation Sites)

Recreation sites are located near El Yunque Peak (El Yunque Peak Observation Tower, La Roca El Yunque, La Roca El Yunque Trail and El Yunque Trail). The scenic value and natural setting is unmatched in the Forest. There are no conflicts between the communication sites and recreation facilities (trails and observation sites). The only conflict would be from a scenery perspective: hiking in a natural setting and ending in an urban-like setting at El Yunque Peak (roads, antennas and concrete structures). There are no recreation sites near Pico del Este Communication site.

Management Area 4 (CIRMA)

This management area provides a unique opportunity to integrate different types of uses in proximity to one another and near communities located at the lower elevations of the Forest. There are numerous trails and facilities that are not in use or are abandoned which could be renovated and put back into use with the shared stewardship of these communities. This management area would greatly contribute to alleviating the current capacity issues on the PR-191 corridor by providing other recreation opportunities outside the corridor.

Management Area 5 (El Toro Wilderness)

This is the only tropical and Puerto Rico's only wilderness area. This area will continue to provide a challenging hiking experience and the opportunity for solitude. Limited permit camping is allowed with limited group sizes and strict camping guidelines.

Management Area 8 (Wild and Scenic Rivers)

The recreation segments of Rio Mameyes and Rio de la Mina are managed following the current comprehensive river management plan. The plan provides guidelines for trash management and proper recreation guidelines that protect the rivers free-flowing condition, water quality, and remarkable values.

Management Area 9 (El Verde Scenic By-Way)

The scenic byway will make the area of El Verde once again accessible to Forest visitors. The byway in essence can provide alternative Forest access and recreation to that provided by the PR 191 corridor. Such access was a common alternative during the 1960s and 1970s during weekends and high visitation periods. There are various river crossings with parking spaces, abandoned picnic area, vista points and trailheads located along the scenic byway. In unity with the CIRMA this management area could become a favorite Forest recreation destination.

Geographic Areas - Recreation

El Norte/North

This geographic area includes the municipalities of Rio Grande and Luquillo. These two municipalities provide the major access points to the Forest as well as the major recreation destinations. Throughout the years both municipalities have provided support to the Forest for special events (Forest Clean Up Day), road maintenance, and improvements to state roads that lead to the Forest and the services and support of their Civil Defense Team during rescue operations related to Forest visitors getting lost or injured. The development of collaboration efforts should continue as the Forest looks to work closer with surrounding

communities. The link to a regional trail system will be an important element in providing recreation opportunities at lower elevations and to adjoining natural reserves such as the Northeast Ecological Corridor.

El Suroeste/ The Southwest

This geographic area considers and addresses the creation of a scenic byway along PR-186 that would contribute to creating alternative recreation destinations for Forest visitors.

El Este/ The East

This geographic area includes and addresses water and watershed protection; which result in better water quality and quantity for visitors of the Forest.

Cumulative Effects

The Forest would cumulatively benefit due to how recreation sites are managed at lower elevations with collaborators and local communities. This alternative will have a positive cumulative effect in protecting cultural resources as well as sensitive ecological resources which are currently being impacted by recreation capacity issues on PR 191, by offering other recreation and cultural resources protection opportunities off PR 191.

Alternative 3

The impacts from this alternative are similar to alternative 2, with the exception of creating more wilderness area. The creation of more wilderness will limit recreation activities.

The effect on the resources are similar to alternative 2, but with the following modifications.

Wilderness Designation for the Baño de Oro Research Natural Area - Recreation

The change from a research natural area to a wilderness area will not impact recreation activity. If wilderness designation is successful, recreation activity will not be affected because there are no recreation facilities or trails in the research natural area. The existing El Toro Wilderness Area is not near or adjacent to the research natural area, which means the physical setting will remain the same.

Facilities and Transportation - Recreation

There would be a plan component to foster the reduction of the trail systems to meet maintenance levels. The elimination of a scenic byway would impact any future recreation opportunities along PR-186.

Management Areas - Recreation

The effects on the management area are the same as in alternative 2, but with the following modifications.

Management Area 9 (El Verde Scenic Byway)

The elimination of this management area will have a negative impact on recreation opportunities along PR-186. Without this designation, the current conditions will remain the same and with time may deteriorate making this area not attractive or inviting to Forest visitors. By not having a scenic byway on the western side of the Forest, congestion of PR-191 would continue and could become worse with more visitation.

Geographic Areas - Recreation

North and South Geographic Areas

The realignment of geographic areas from three to two areas would not affect recreation activities. Most of the recreation activities occur on the North Geographic Area and access to the Forest would remain the same.

3.5.6 Wilderness and Inventoried Roadless Areas

3.5.6.1 Affected Environment

Congressionally designated wilderness areas are protected by the Wilderness Act (P.L. 88-577 (16 U.S. C. 1131-1136)) and valued for their ecological, historical, scientific and experiential resources. Outdoor recreation is one of the benefactors of wilderness and is one of the drivers of wilderness demand and management. According to trend data collected from 1965 to 1994, the trend in recreation visits to national forest wilderness areas has paralleled designations and use has increased over time. In addition to outdoor recreation in wilderness, a non-user component that values American wilderness also exists and is important to understand when analyzing areas that may be suitable for wilderness allocations.

Wilderness is valued for preserving representative natural ecosystems and local landscapes. The very existence of wilderness is valued by the American public as part of the natural heritage of the country.

El Yunque National Forest is home to one designated wilderness area: El Toro Wilderness, which is made up of 10,352 acres. On El Yunque National Forest this represents about one-third of the total Forest acreage. Annual wilderness use for El Yunque National Forest is about 1,000 visits per year, or about 0.5 percent of total visitor use.

Table 3-47. Existing designated wilderness areas

Wilderness Area	Acreage
El Toro Wilderness	10,352

The existing wilderness areas should maintain the areas' natural characteristics. Four qualities help describe wilderness character:

1. *Untrammeled*. Wilderness is essentially unhindered and free from modern human control or manipulation.

2. *Naturalness*. Wilderness ecological systems are substantially free from the effects of modern civilization.

3. *Undeveloped*. Wilderness is essentially without permanent improvements or modern human occupation.

4. *Outstanding opportunities for solitude or a primitive and unconfined type of recreation*. Wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge.

Affected Environment Inventoried Roadless Areas

Inventoried roadless areas are designated areas under the Roadless Area Conservation Rule (RACR, 36 CFR Part 294). The Forest Service first inventoried these areas in 1972, as part of the Roadless Area

Review and Evaluation phase I (RARE I). A second inventory was completed for RARE II in 1977 and then in the RACR in 2001. El Yunque National Forest has one inventoried roadless areas on the Forest, which is the same area as the expanded Baño de Oro Research Natural Area (6,441 acres).

Table 3-48. Inventoried roadless areas, approximate GIS acreages

Roadless Area Acres	Acreage
Baño de Oro	6,441

Areas that May be Suitable for Wilderness Designation

The first step in the evaluation of areas that may be suitable for wilderness designation is to identify and inventory all areas that satisfy the definition of wilderness. Direction can be found in Section 2 (c) of the 1964 Wilderness Act and Forest Service Handbook 1909.12, Chapter 70–Wilderness Evaluation.

The Forest Service must evaluate lands that meet the inventory criteria for areas that may be suitable for wilderness during plan revision and, from the information gathered in that evaluation, consider alternatives for recommending wilderness. The previous planning process identified two areas as lands that may be suitable for inclusion in the National Wilderness Preservation System. These two inventoried areas totaled 23,600 acres out of the total 28,223 acres in El Yunque. None of the remaining acres meet the criteria for being included in an inventory of areas that may be suitable for wilderness designation. Of these two areas, one, El Toro area, became designated as El Toro Wilderness Area in 2005. The second area is the Mameyes Area (of approximately 11,000 acres), which includes the Baño de Oro Inventoried Roadless Area of 6,441 acres.

Table 3-49. Areas on El Yunque that may be suitable for wilderness designation

Area	Acreage
Mameyes area	(Approximately) 11,000 acres

The Mameyes area was then further evaluated as to its suitability for wilderness designation (see appendix D). Based on this information, the planning team considered alternatives with varying amounts of recommended wilderness. Recommended areas would be managed to maintain their wilderness character until they are officially designated by Congress and added to the National Wilderness Preservation System.

Under alternatives 1 and 2, no additional areas would be recommended for wilderness designation. However, in alternative 3, the portion of the Mameyes area that is an inventoried roadless area would be recommended for wilderness designation.

Table 3-50. Summary recommendations by alternative

Existing Area	Alternative 1	Alternative 2	Alternative 3
El Toro Wilderness (acres)	10,363	10,352	10,352
Inventoried Roadless Area (acres)	6,441	6,441	
Proposed Additional Wilderness (Baño de Oro) (acres)	0	0	6,441

Wilderness has many positive effects. As stated previously, wilderness preserves natural systems and provides places of solitude for visitors. However, there are environmental effects within wilderness from many sources. Four previously defined wilderness characteristics are considered for effects, (1) untrammeled, (2) naturalness, (3) undeveloped; and (4) outstanding opportunities for solitude or a primitive and unconfined type of recreation.

Recreational use can negatively impact the four wilderness characteristics, especially the opportunity for solitude and naturalness. Some of these negative impacts, especially on naturalness, include the following:

1. Soil compaction;

2. Vegetation loss, disturbance and/or replacement by invasive species such as noxious weeds on trails and campsites caused by recreation use;

3. Deterioration of water quality from improper disposal of human waste and waste water; and

4. Loss of or threats to biological/ecological processes and biodiversity through human disturbance.

Other environmental effects which impact the integrity of the natural systems in wilderness include air pollution from outside sources, interruption of natural functioning ecosystems by fire suppression, and threats to native plant species from the spread of noxious weeds from sources outside wilderness.

3.5.6.2 Environmental Effects

Effects Common to All Alternatives

All alternatives carry forward the need for wilderness patrols, wilderness rehabilitation of any impacted sites, wilderness education, and wilderness-specific management plans. These effects are common to all alternatives.

There would be no negative effects to the roadless character of inventoried roadless areas on the Forest from these alternatives. All of these areas have a recreation opportunity setting of "semi-primitive motorized" or "semi-primitive non-motorized" and would continue to implement the direction from the 2001 Roadless Area Conservation Rule (RACR) on limiting road construction and tree cutting in these areas.

Alternative 1

Wilderness and Recommended Wilderness

Alternative 1 would not recommend any new wilderness study areas on El Yunque. The management direction for El Toro Wilderness would continue as it is currently being managed.

Inventoried Roadless Areas

The Baño de Oro inventoried roadless area would continue to be managed as a part of the proposed expanded Baño de Oro Research Natural Area. There would be no negative effect to the roadless character of the inventoried roadless area.

Opportunities for solitude and remoteness may decrease. Sights and sounds of man's activities may be more obvious. Noise levels and soil erosion may increase. Air and water quality may decrease although water quality would meet state and Federal standards. There would be no negative effect to the roadless character of inventoried roadless areas on the Forest from this alternative. The areas have a recreation

opportunity spectrum setting of "semi-primitive motorized" and would continue to implement the direction from the 2001 Roadless Area Conservation Rule on limiting road construction and tree cutting in these areas.

Alternative 2

Wilderness and Recommended Wilderness

Alternative 2 would not recommend any new wilderness areas. Like alternative 1, the management direction would follow that for El Toro Wilderness area.

Inventoried Roadless Areas

The Baño de Oro Inventoried Roadless Area would continue to be managed as a part of the expanded Baño de Oro Research Natural Area. There would be no negative effect to the roadless character of the inventoried roadless area.

Alternative 3

Wilderness and Recommended Wilderness

Under alternative 3, the management direction for El Toro Wilderness Area would continue as it is currently being managed. The 6,141-acre Baño de Oro Inventoried Roadless Area would be recommended for wilderness designation. The 2,172-acre formally designated Baño de Oro Research Natural Area that is within the inventoried roadless area would become a part of the recommended wilderness. However, the proposal to officially expand the research natural area would not be pursued.

The recommended area would be managed the same as designated wilderness until a final determination is made by Congress as to whether it should be added to the National Wilderness Preservation system.

The primary change to the management of the Baño de Oro area under this alternative is that the area would be managed as a wilderness area instead of as a research natural area. This would have the effect of potentially increasing the recreational use of the area. Any research activities that would involve manipulating vegetation within this area, which could occur under alternatives 1 or 2, would not be conducted under this alternative. Water quality and air quality should remain good and the imprint of man's influence would not increase or would diminish over time. On some occasions there may be restoration of degraded resources in the recommended wilderness area, i.e., invasive eradication or control.

Opportunities for solitude and remoteness would potentially increase as would the opportunity for primitive and unconfined recreation due to the reduction of research-related activities. Additional acreage for wilderness would allow wilderness user impacts to be dispersed across a larger area providing an increase in wilderness visitor satisfaction. Maintenance of trails and facilities would be limited to using hand tools only.

Educational opportunities for the scientific study of natural ecological processes would increase with the increased acres in wilderness. The naturalness, uniqueness and representative ecosystems of the designated areas would be maintained

Inventoried Roadless Areas

In alternative 3, the Baño de Oro Inventoried Roadless Area is recommended for wilderness designation.

3.5.7 Wild and Scenic Rivers

3.5.7.1 Affected Environment

The Wild and Scenic Rivers Act (Public Law 90-542: 16 USC 1271-1287, October 2, 1968) and its amendments provide for the protection of selected rivers and their immediate environments. To be eligible for designation, rivers must possess one or more outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values. Designation preserves rivers in free-flowing condition, protects water quality, and protects their immediate environments for the benefit and enjoyment of present and future generations.

Most rivers are added to the National Wild and Scenic Rivers System (National System) through Federal legislation, after a study of the river's eligibility and suitability for designation. The Forest Service is required to consider and evaluate rivers on lands they manage for potential designation while preparing their broader land management plans under Section 5(d)(1) of the Act.

Rivers and stream corridors accommodate different uses such as picnicking, day hiking, and walking for pleasure, primitive camping, swimming and nature study.

Demand for river designation is expressed primarily through public comment and responses to agency proposals. The degree to which the public input favors designation indicates the demand for a wide range of uses, activities, and resource qualities associated with river management.

Although demand is closely related to the current population and the projected growth of the local area, designation would likely produce increased levels of recreation use in designated and potential corridors.

Designated Rivers on El Yunque National Forest

The Caribbean National Forest Wild and Scenic Rivers Act of 2002 designated the following three rivers as part of the National Wild and Scenic River System: Rio Mameyes, Rio de la Mina, and Rio Icacos.

Non-Eligible/Eligible Rivers

In previous planning efforts, rivers on El Yunque National Forest were considered for wild and scenic river eligibility. During the current planning effort another evaluation was done. Three streams or rivers in El Yunque were reviewed for potential eligibility. Rivers/streams must possess at least one outstandingly remarkable value (ORV) to be considered eligible. These streams were classified according to Section 2 of the Wild and Scenic Rivers Act. Table 3-51 shows the rivers that were studied and found eligible. (See also appendix C.)

During this plan revision, any additional evaluation of rivers/streams was limited to the evaluation of any rivers or streams that were not previously evaluated for eligibility, or any rivers or streams with changed circumstances. However, the previous planning effort evaluated all the potential streams, and there has been no change in circumstances.

Table 3-51. Rivers studied for national wild and scenic river system

River	Miles	Preliminary Classification
Rio Espíritu Santo/ Quebrada Sonadora	2.9	Wild
	0.8	Scenic
Rio Fajardo	3.4	Wild
Rio Sabana	2.3	Wild
	0.3	Recreation

3.5.7.2 Environmental Consequences

The identification of a river for study through the Forest planning process does not trigger any protection under the act until designation by Congress. Importantly, identifying rivers as eligible, or eligible and suitable, does not create any new agency authority; rather, it focuses the management actions within the discretion of the Forest Service on protecting identified river values. For eligible rivers, the preliminary (inventoried) classification is to be maintained absent a suitability determination. The recommended classification is to be maintained throughout the duration of the Forest plan. Protection of rivers and streams through the Forest planning process helps to assure high-quality, free-flowing rivers and streams, as well as river-related recreation opportunities.

Management emphasis for the eligible rivers and their corridors is focused on protection and enhancement of the values for which they were established, without limiting other uses that do not substantially interfere with public use and enjoyment of those values. The establishment values (outstandingly remarkable vaules) for the rivers on El Yunque National Forest include scenic, recreational, geological, fish and wildlife, historical, cultural or other values including ecological.

Most impacts to all rivers come from activities outside the river corridor. However, Forest management would be subordinate to the river's outstandingly remarkable vaules. Vegetation management, road construction and construction or removal of recreation facilities could cause erosion along the river, sedimentation from soil runoff, visual intrusions or noise from nearby activities

Increased public interest and use may result with the creation of CIRMA by having additional trailheads and trails and access points to the river to accommodate additional public interest and use of the river. However, increased recreation use due to designation may also result in more river-related activities and cause localized increases in soil compaction and erosion of stream banks and the need for limited public access.

River sections classified as scenic or recreational are managed with a wider variety of activities allowed within the river corridor. However, Forest management would be subordinate to the river's outstandingly remarkable vaules. Sights and sounds of man's activities would be more apparent. Management activities that have the greatest potential of affecting rivers and their potential suitability for scenic or recreation designation are road construction, vegetation management, insect and disease control, and special use utility right-of-ways. Other management activities that also can affect the river resources to a degree are threatened and endangered species habitat management, recreation and administrative site facilities. A "wild" classification, however, would be expected to have a smaller range of effects from activities within the river corridor (e.g., no new roads, no new rights-of-way or wildlife openings).

Non-eligible Rivers

Any river determined to be not eligible may be managed on El Yunque National Forest under a variety of management areas, geographic zones, and special designations. These prescriptions will allow a wide variety of activities within the river corridor. Management activities may include road construction, vegetation management, insect and disease control or special use utility right-of-ways. Other management activities that also can affect the river resources to a lesser degree are threatened and endangered species habitat management, recreation and administrative site facility construction and wildlife and fisheries management.

Effects Common to All Alternatives

Under all alternatives, the three eligible wild and scenic rivers would retain their eligibility in accordance with Forest Service manual and handbook direction until they are evaluated for suitability and either

designated or released. This means that they would be maintained in their free-flowing condition and their identified outstandingly remarkable vaules would be retained.

Faced with the challenge of managing the recreation segments of the existing designated wild and scenic rivers, the Forest does not have the management capacity and resources to pursue additional wild and scenic river designations. All of the streams and rivers that originate in the Forest will maintain their free-flowing condition, water quality and their "outstanding remarkable" values, so in essence they are being managed as wild and scenic rivers. The rivers conditions within the Forest were analyzed and determined to be in a good state (see 2014 Forest Plan Assessment).

3.5.8 Special Uses

Special uses are an integral part of the management of the Forest. It allows individuals and organizations to use resources provided by the land.

After the passings of hurricanes Irma and María, the only foreseeable change in Special Uses is the reduction of recreational residences in the Forest due to the damages caused to them, although right before the hurricanes there were only 3 recreational residences remaining.

3.5.8.1 Affected Environment

Special uses permitted include areas for electronics and communications, temporary housing and camps, and water supply. Temporary permits are issued for projects such as recreation events, research, and filming/photography. Current permitted special uses are summarized in the following table.

Table 3-52. Summary of special use categories

Special Use Category	Number of permits given in 2012
Communication Sites	8
Filming and Photo	18
Food Concession	1
Organization Camp (e.g., Girl Scouts)	1
Outfitters and Guides	30
Recreational Residences	3
Recreation Events	15
Research	18
Road Right-of-Way	9
Water Right-of-Way	20

Electronic facilities, water systems, tours and outfitters, and research are the predominant special uses on the Forest. Research and outfitters/guides permits make up the vast amount of services requested by individuals and institutions. Communications and water intakes make the bulk of governmental requests for permits.

3.5.8.2 Environmental Effects

Alternative 1

Water – Special Uses

The permitted extraction of water from the Forest will have the effect of supplying the local community with a water supply while at the same time controlling the extracted amount to benefit the health of the aquatic habitat.

New Developed Recreation Areas – Special Uses

Access to the area by means of permitted outfitters and tours will have the effect of opening new areas of the Forest to tourism. The concentration of permitted use of the developed areas will potentially reduce the effects of dispersed recreation on other areas of the Forest, thus reducing damage to the natural environment and resources in the Forest overall.

The permitted use of the new developed areas will increase the likelihood of damage to the natural and cultural resources in or near the vicinity of the developed areas.

Minerals – Special Uses

The extraction of minerals will not be permitted. This will have the effect of ensuring the health of the ecosystem, and other resources as well as the maintenance of healthy recreation, scenic and other natural forest values. The ban on the extraction of minerals from the Forest will have the direct effect of eliminating economic enterprises on this sector within the Forest.

Vegetation – Special Uses

The permitted collection of plants and plant material (fruits, seeds, etc.) from the Forest will have the effect of reducing unchecked damage to the flora while at the same time providing access to it under justifiable means. The requirement of a permit for the salvage of timber allows the extraction of naturally fallen trees for non-economic, justifiable means, thus protecting the visual and ecosystem quality of the Forest.

Permits - Special Uses

The requirement of permits for all commercial activities in the Forest will have the effect of ensuring control of such activities, while allowing the population and enterprises to benefit from the Forest. The Special Uses Program allows the use of the Forest for military exercise while placing specific parameters for that use. Such controls will have the effect of reducing the footprint of the activities on the Forest and its resources and will reduce the visual impact to the visitor. The control of water intakes and research will have the direct effect of reducing the impacts of such activities while keeping the Forest open to them.

Recreation – Special Uses

The requirement of permits for camping will ensure user safety while minimizing direct environmental impact on the Forest.

Facilities and Transportation – Special Uses

The permitted use of Forest facilities for the Puerto Rican parrot recovery program will have the effect of enhancing the success rate of the recovery efforts.

Wild and Scenic Rivers – Special Uses

The ban on permits for the construction of dams within the waterways in the sections cataloged as "wild rivers" will have the effect of ensuring the health and character of the rivers under this classification. It can also have the effect of reducing available water reserves for the use of the community under extreme weather conditions such as drought.

Research and Demonstration – Special Uses

The permitted use of certain areas of the Forest for research and demonstration activities will have the effect of ensuring that the ecosystem and resources are protected while allowing those activities that are justifiable and beneficial for the greater good.

Management Areas – Special Uses

Management Area 2 (Developed Recreation)

The termination of permits for recreational residences that are no longer in use will have the effect of reducing the footprint of such structures and activities in the Forest. The discontinuation of their use will have the indirect effect of allowing the natural ecosystem around them to recover.

Management Area 3 (Communication Sites)

The ban on constructing new facilities, and consolidating permitted activities to a few sites, will have the effect of reducing the environmental, visual, and audio impact of the communication activities in the Forest. Removing the communication equipment around El Yunque Peak Tower Heritage Site will have the effect of returning the sense of feeling to the site to its original intended purpose of an isolated observation tower. The goal of having one special use permit holder per facility manager will have the effect of reducing administrative burdens on the Forest. It could also have the indirect effect of reducing accessibility to the sites given that the discretionary use would be in the hands of the permit holder. The ban on new land clearings and new road constructions will have the effect of protecting the environment both directly and cumulative.

Management Area 7 (Research Natural Area)

The permitting of research activities within this area will allow access to investigators and the placement of temporary equipment. This could have the cumulative effect of enhancing the understanding of the Forest ecosystems in the long run. The ban on permitted facilities or occupation will have the effect of preserving the environment and the natural qualities of the area.

Alternative 2

Water – Special Uses

The ban on new water intake permits could have the effect of reducing availability of water to the communities in times of drought or if recent drier weather patterns start to prevail.

Wildlife – Special Uses

Research activities as well as third party land management practices that can provide benefit to habitat (i.e., agroforestry activities) will require a permit. This will increase monitoring of activities, the results of which would allow better management of the resource and a reduction in the possibility of direct adverse effects on the fauna.

The conditioned permitted extraction of water will have the effect of securing a stable supply of water to maintain the aquatic habitats.

Socioeconomics – Special Uses

All economic activities provided by the Forest to individuals, institutions, or communities will require a permit. This will include outfitting/guide services, resources collection and extraction, research, educational and interpretation activities. This will have the effect of providing a better quality of services, information, education, interpretation and other activities to the people and communities.

Ecosystem Services – Special Uses

The permitted use of ecosystem services has the effect of providing resources and services while at the same time ensuring the protection of the environment and resources.

Recreation – Special Uses

The requirement of permits for outfitting services, vending services, food concessionaires, and other for-profit activities will have the direct effect of controlling illegal activities and uses. It will have the indirect effect of enhancing the recreational and interpretative offering to the visitors. The use of outfitters might have the cumulative effect of reducing impacts on the Forest and recreation areas caused by high traffic, and individual vehicular use. The use of permitted outfitting/guides could have the effect of increasing peak visitation numbers to the Forest.

Forest Products – Special Uses

The controlled and permitted extraction of Forest products will have the effect of reducing illegal activities and uses on the Forest and its resources. It will also have the indirect effect of allowing for the better management and monitoring of the area and its resources.

Permits - Special Uses

Special use permits make the land, its resources, and opportunities available to the public, government, and entities. Special use permitting also has the direct effect of supporting communities and the economy. Permitted communication, water, research and military uses has the effect of enhancing the productivity of the Forest to the benefit of society in general. The implementation of the special uses program has the effect of securing accountability, transparency, equality and efficiency. It also has the indirect effect of helping manage, protect and monitor other resources and management areas.

Cultural Resources – Special Uses

All cultural resource-related research by individuals and organizations outside the Forest Service will require a special use permit.

Facilities and Transportation – Special Uses

All use of the communication equipment in the Forest will require a special use permit and will be limited to the communications management area. No new communication structures will be permitted.

The permitted use of existing infrastructure could have the effect of reducing maintenance costs.

The continuous support of the parrot aviary will have the effect of improving recovery conditions to the Puerto Rican parrot.

Minerals – Special Uses

The ban on the permitted extraction of minerals limits will have the effect of limiting access to resources by the public.

Research – Special Uses

The permitting of research activities will have the effect of filtering beneficial research and will help control research activities which could affect other resources such as scenery, recreational opportunities, water and air, etc.

Management Areas – Special Uses

Management Area 2 (El Yunque/Yokahu Zones)

The focus on recreation on this area will impact the special uses program because of the focus on outfitted/guided alternative use of this area. Because outfitting permits are being issued to individuals, monitoring and enforcement would improve, but so would the workload. Permitting and the associated monitoring of vending and concessionaire activities will have the effect of increasing visitor's recreational opportunities and available facilities and services. Special use permits for the use of vacant infrastructure will help reduce deferred maintenance costs. It could also have the direct effect of rehabilitating historic infrastructure.

Management Area 3 (Communications)

The proposed removal of communications facilities from the east end of El Yunque Peak Site and Pico del Este area will mean that no new constructions will be authorized and that all new and proposed permitted communication activities will be limited to the existing infrastructure in the area. This will have the direct effect of reducing noise, traffic, and scenic contamination. It will have the indirect effect of reducing damage to the access road by reducing the amount of infrastructure in need of maintenance and refueling. The reduction in traffic will also have the effect of increasing hiker safety on the route by reducing encounters between vehicles and people.

Management Area 4 (Community Interface Resource Management Area)

The controlling and permitting of activities within the Community Interface Resource Management Area (CIRMA) will have the effect of protecting the resources and land while allowing the use of the area and the establishment of projects from the community, collaborators, and enterprises. It will also have the indirect effect of aiding in the management and monitoring of the area and its resources. The management of special use permits within the CIRMA will also have the direct effect of reducing illegal activities and uses on the Forest and its resources within the CIRMA. We expect to see an increase in the collection and extraction of Forest resources if the CIRMA is implemented.

Management Area 5 (Wilderness)

The permitting of the limited outfitting and research activities within the wilderness will have the direct effect of reducing unintended damage to the resources and will maintain the wilderness characteristics of the area.

Management Area 6 (Research)

The issuing of permits for research will have the direct effect of reducing unintended damage to the resources and will help conserve/preserve the resources and the environment.

Management Area 7 (Baño de Oro Research Natural Area)

The requirements of permits for any activity in the area will have the direct effect of reducing unintended damage to the resources and will help conserve/preserve the resources and the environment.

Management Area 9 (Scenic By-Way 186)

The issuing of permits for enterprises will have the effect of allowing the development and implementation of projects, enterprises, and initiatives within the corridor, while at the same time helping to preserve the environment, nearby wilderness character, cultural resources, and infrastructure around the corridor. The establishment of such ventures could have the indirect effect of increasing Forest Services' and partners' visibility in that area of the Forest, which will increase the level and feeling of safety and monitoring of the area.

Geographic Areas – Special Uses

No significant effects are foreseen for the differences in the geographic areas.

Alternative 3

The effect of the resources' desired future conditions are the same as in alternative 2, with the following differences.

Extension of Wilderness to Research Natural Area – Special Uses

This will limit the permitted activities to those allowed by the standard and guidelines outlined for the wilderness area. The regulation of the limited outfitting and research activities within the wilderness will have the direct effect of reducing unintended damage to the resources and will maintain the wilderness characteristics of the area. It will also have the direct effect of prohibiting new water intakes within the boundaries of the area.

Management Areas – Special Uses

The effect of the resources within the management areas are the same as in alternative 2, with the exception of the lack of management area 9 (scenic byway) in this alternative.

Geographic Areas – Special Uses

No significant effects are foreseen for the differences in the geographic areas.

3.5.9 Scenery

Scenery varies depending on existing natural features, which include vegetation, water features, landforms, geology, and human-made elements. Scenic character is a combination of the physical, biological, and cultural images that give an area its scenic identity and contributes to its sense of place. The landscape of El Yunque National Forest has a wide variety of features that provide for some of the most spectacular scenery found anywhere in Puerto Rico. El Yunque has a variety of scenic settings from dense, enclosed picnic areas and trails, to cloud covered peaks and observation towers, which on clear days have vistas of the Atlantic Ocean and Caribbean Sea. The Forest also has many prehistoric and historic sites adding richness of character and culture. Scenery combines all the ecological features and human elements which together give a landscape its character and image. Viewing the natural scenery is one the major reasons most visitors have for visiting to the Forest (NVUM 2011).

The development on neighboring lands negatively impact the scenic resource as visitors approach the Forest along several state roads. Understanding the value of Forest scenery to the local communities is important as it affects real estate values and quality of life. In addition to other Forest natural resources, the scenery resource must be preserved and managed for future generations

3.5.9.1 Affected Environment

All Forest visitors' activities are experienced in a scenic environment defined by the arrangements of the landscapes' natural elements combined with components of the built environment. The natural scenic beauty of the Forest stands out, making it a major local and international recreation destination. Roads off-Forest as well as Forest roads, trails, and recreation sites are key components for viewing scenery, especially along the PR-191 Recreation Corridor.

Large areas of the Forest contain naturally evolving landscapes where processes occur with very little human intervention. The scenic character is basically intact with only minute deviations. Views beyond the immediate background are influenced by the viewer's elevation and forest type and density. Vegetation is dense with tall trees and large canopies while at the upper elevations the trees and palms are shorter and less dense with more shrubs and tall grasses. Currently, after hurricanes Irma and Maria, most of the vegetation has regrown its leaves; however many trees lost its branches and is a persistent characteristic of the forest structure. If another major hurricane does not impact the forest in the next 20 years, the views of a dense forest will again be seen.

Most of the Forest areas have a natural appearing scenic character. Deviations in the scenic character borrow from elements in the landscape. Roads and trails area a part of the natural appearing landscape, offering opportunities to view scenery. Historic structures such as the observation towers (Yokahu and Mount Britton) are noticeable, but borrow from the landscape elements and are positive cultural elements which add to the valued scenic character.

In all alternatives there would be little to no change in the landscape character of natural appearing and natural evolving. Alternatives 2 and 3 would result in more protection and enhancement to the scenic resources because of the focus on protecting the resources.

3.5.9.2 Environmental Consequences

All Alternatives

The scenic resource is affected by management activities that alter the appearance of what is seen in the landscape. Scenic effects are usually considered in terms of visual contrast with existing or adjacent conditions that result from management activities.

Due to the heavy concentration of recreation areas in the PR-191 Recreation Corridor, traffic congestion and overcrowding of favorite sites and parking areas continues to be a problem. Recreation use beyond capacity may cause natural resource damage adjacent to recreation sites, roads, and trails, affecting the naturally appearing scenery adjacent to these areas. Traffic congestion may affect access and opportunities to view scenery. There are management activities and areas that can result in visual alteration. Those that have the greatest potential of affecting scenery include the following:

- Road construction
- Vegetation management
- Special use utility right-of-ways

Other management activities that can also affect the scenery resource include:

- Threatened and endangered species habitat management
- Communication sites
- Administrative and recreation facilities construction

Changes to scenic conditions across the landscape mostly occur through natural processes such as hurricanes, tropical storms, tree falls, and landslides with naturally evolving landscapes. These natural disturbances will continue to shape the vegetation and landform features of the landscape.

Alternative 1

This alternative follows the desired future condition, goals, and standards and guidelines that appear in the 1997 Forest Plan. The scenery resource continues to be one of the most valued and enjoyed amenities by visitors. The scenery goals are set to protect, enhance, and where necessary, restore the scenery values of the Forest by considering the former visual quality objectives in resource planning and management, demonstration, and research activities.

Alternative 1 does not contemplate an "all-lands" approach for management and collaboration of scenic values, retaining the complete authority and responsibility of managing the scenery within the National Forest. This policy limits the strategies the Forest has to reduce the visual impacts of land fragmentation on the overall scenic viewshed.

Developed Recreation - Scenery

Addresses recreation demands and development which would have an impact on the natural scenery. It could alter the natural setting and limit the natural scenic character, which is a recognizable value for the Forest and its visitors.

Wild and Scenic Rivers - Scenery

The designation and management of the wild and scenic rivers protects the scenery and outstanding remarkable values of the rivers while providing a scenic enjoyment opportunity for Forest visitors.

Wilderness Area - Scenery

Protects the scenery and natural setting that is found in this area.

Management Areas - Scenery

All management areas would continue to meet their former visual quality objective ratings:

Table 3-53. Management area visual quality objective ratings

Management Area	Visual Quality Objective Rating
MA 1 Administrative Sites	Partial Retention
MA 2 Developed Recreation	50 percent Retention
MA 3 Communication Sites	Modification
MA 4 Integrated	75 percent Retention, 20 percent Partial Retention, 5 percent Modification
MA 5 Wilderness	95 percent Preservation
MA 6 Research	40 percent Retention
MA 7 Research Natural Area	100 percent Preservation
MA 8 Timber Demo.	50 percent Partial Retention, 10 percent Modification
MA 9 Scenic and Recreational Rivers	5 percent Partial Retention

Alternative 2

This alternative addresses the protection of the resources. Scenery will continue to be a valued resource and will be managed accordingly.

Alternative 2 considers an "all-lands" approach for management and collaboration of scenic values. This strategy provides the Forest broader opportunities to manage scenic viewshed which can help improve and maintain scenic character values that are affected by land fragmentation and peripheral urbanization, a growing issue for the region (see the 2014 Forest Plan Assessment).

Developed Recreation - Scenery

Addresses recreation demands, but development is a lot less than alternative 1, which would have less impact on the natural scenery of the Forest. The development of recreation under this alternative would consider existing infrastructure at the lower elevations of the Forest, which would also impact the natural setting, but in a much reduced way.

Wild and Scenic Rivers - Scenery

The designation and management of the wild and scenic rivers protect the scenery and outstanding remarkable values of the rivers while providing a scenic enjoyment opportunity for Forest visitors.

Riparian Zones - Scenery

Riparian restoration under this alternative is more intense and the land acquisition program for the Forest considers acquiring riparian zones as a priority. This could help the management and protection of the scenic value that rivers possess with the Forest.

Wilderness Area - Scenery

Protects the scenery and natural setting that is found in this area.

Management Areas - Scenery

Management Area 1 Administrative

Scenery is impacted by structures, parking areas, roads, utilities and signage. The natural forest is a scenic background for these built elements. The scenic character of this management area closely resembles that of an urban/rural landscape. Under this alternative no new infrastructure will be developed within this management area, therefore the impact to the natural setting could be less.

Management Area 2 El Yunque Recreation Zone

This management area is highly developed with picnic shelters, bathrooms, trails, roads, parking, observation towers and road and trail signage. The Forest scenery is closely integrated to the built environment. Under this alternative no new infrastructure will be developed within this management area, therefore the impact to the natural setting could be less.

Management Area 3 Communication and Recreation

Communication antennas located at El Yunque Peak are highly visible when viewed from afar or after hiking for several hours and arriving at the peak. The communication site at Pico del Este is also visible from off the Forest and from key points within the Forest. The predominate cloud conditions at these peaks during most of the year greatly reduces the negative scenery that these antennas represent.

Management Area 4 Community Interface Resource Management Area

This management area will have some scenery impact as alternative sites are reused or restored at the Forest's lower elevations. Most of the scenery impact will be along existing roads that provide access to the Forest.

Management Area 5 El Toro Wilderness Area

This management area would retain its natural scenic character. There would be minimal scenery impact because there would be no new trails developed in this area. Any trail maintenance would have some scenery impact but would be for a limited amount of time when trail work would be done.

Management Area 6 Research

Scenery would be impacted in this management area where research plots are located. These sites are located in very isolated parts of the Forest and are not visible from roadways or recreation trails.

Management Area 7 Baño de Oro Research Natural Area

Scenery would not be impacted.

Management Area 8 Wild and Scenic Rivers

Scenic character would be managed by the comprehensive river management plan. The plan addresses the protection of the rivers outstanding remarkable values which includes the rivers scenic beauty.

Management Area 9 Scenic Byway PR-186

This management area will greatly contribute to improving the scenery along this roadway. Scenic byway designation will prioritize the importance of providing a scenic experience to people that travel on this section of PR-186.

Geographic Areas - Scenery

All geographic areas will continue to have the same scenic opportunities. Access roads to the Forest will continue to be the same. The North Geographic Area will continue to have the most used access routes to the PR-191 Recreation Corridor and the CIRMA.

Alternative 3

The effect on the scenery resource is the same as in alternative 2. This alternative would have added wilderness area acreage.

Resources - Scenery

The effects on the scenery resources is the same as in alternative 2.

Management Areas - Scenery

MA 9 Scenic Byway

Eliminating the scenic byway designation will have a negative impact on the scenery along the PR-186 roadway that crosses the Forest. The scenery resource will not be managed at the level of a scenic byway.

Geographic Areas - Scenery

All geographic areas will continue to have the same scenic opportunities. Access roads to the Forest will continue to be the same. The North Geographic Area will continue to have the most used routes to the PR-191 Recreation Corridor and the CIRMA.

Cumulative Effects

Under all alternatives the cumulative effects on the scenery of the Forest would be the same; considering the management under the alternatives protect scenery within the Forest with minimal impacts. The scenery from a broader landscape perspective is not managed within the alternatives but there are possible positive impacts from alternative 2 and 3 which propose collaboration and an "all-lands" approach.

3.5.10 Infrastructure

3.5.10.1 Affected Environment

Infrastructure in the Forest is varied and vast, and consists of buildings, roads within the Forest boundaries, external roads, parking, transit, trails, research facilities, recreation facilities, abandoned facilities, water intakes, and non-Forest service buildings. Much of the infrastructure on the Forest is already considered a historic asset. The Forest infrastructure supports recreation, communications, access, water supply, research, and resource management. The main infrastructure within the Forest includes:

- 11.27 miles of National Forest System roads.
- 34 permitted water intakes.
- 1 Forest headquarters compound.
- 1 Visitors center (El Portal del Yunque).
- 1 aviary facility.
- 1 quarters building El Verde site.
- 1 El Verde storage area.
- 3 observation platforms (Yokahu Tower, Mt. Britton Tower, and Los Picachos platform).
- 2 research stations (Long Term Ecological Research Station Site and Sabana Field Research Station).
- Living quarters in research stations.
- 3 open picnic áreas (Palo Colorado and Palma de Sierra, El Verde).
- 2 stores.
- 13 open trails.
- 7 empty historic structures.
- 2 closed pools (Baño de Oro and Baño Grande).

Forest Service buildings and structures (both administrative and recreation) support administrative and recreation programs across El Yunque National Forest.

A facility master plan would be developed to guide the acquisition, continued use, maintenance, improvements and disposal of Forest Service facilities on El Yunque National Forest. The plan would propose an overall reduction in facilities through consolidation and decommissioning.

The passing of hurricanes Irma and Maria in late 2017 had severe impacts on the forest infrastructure. The two main administration buildings (headquarters and visitor center) were moderately damaged during the events. The damage extended to the water supply system, including intakes and distribution system that feed the headquarters and visitor center, as well as a partial collapse of the sewer systems. The electric system in the forest was completely destroyed or failed during the emergency. This included the backup electrictricity generator system which failed after prolonged use during the emergency. The main roads suffered landslides and two catastrophic failures, necesitaning the closing of the forest and severely limiting access to the vital communication sites on the higher parts of El Yunque. Recreation related infrastructure suffered significant damages, including landslides or bed failures on trails, damaged picnic

shelters, and damage to recreation related historic infrastructure. Overall significant forest infrastructure will require large amounts of reconstruction, restoration or overall replacement. The effects of the hurricanes highlighted the fragility of the current systems when confronted with severe weather events. The collapse of the infrastructure also had severe impacts on the recreation offering and socioeconomic opportunities provided by the forest including lack of access for tourism, telecommunications, research, and national defense.

3.5.10.2 Environmental Consequences, All Alternatives

Alternative 1

Alternative 1 would not change the way the Forest is managing the lands, it would simply implement the 1997 Forest Plan with the Forest's current condition. This alternative does not propose the new requirements or the aspect of sustainable (ecological, social, and economic) use within the Forest; nor is the concept of collaboration a foothold to management.

New Developed Recreation Sites (Recreation Facilities and Transportation) - Infrastructure

The proposed construction of new recreation areas can have the effect of dispersing recreation use stress on the existing infrastructure, thus reducing likelihood of vandalism, wear, and damage on existing recreation.

Environmental Education - Infrastructure

The proposed educational and interpretive offering could have the indirect and cumulative effect of increasing awareness on the function, use, and importance of the existing recreational infrastructure. That could have the indirect effect of reducing misuse and vandalism because of the increased awareness of the importance of the resource.

Management Areas - Infrastructure

Management Area 1 (Administration sites)

The proposed reconstruction of trails could affect their historic integrity of many of the historic trails.

Management Area 2 (Developed Recreation)

The limitations on recreational activities in this area will have the indirect effect of reducing use stress and disturbances to the resources located in the other management areas.

Management Area 3 (Communications Sites)

The proposed removal of communications facilities will reduce maintenance costs and traffic in the area. This also has the potential indirect effect of enhancing the natural environment by reducing use of the area.

Management Area 5 (Wilderness)

The wilderness area has the effect of increasing the difficulty and costs involved in the maintenance and repairs of the existing trails through the wilderness.

Alternative 2

Socioeconomic Resources - Infrastructure

Potential leasing of vacant infrastructure could have the effect of reducing management and maintenance costs and of enhancing and preserving the historic character of historic infrastructure, if implemented following the standards and guidelines outlined in the management plan.

Environmental Education - Infrastructure

The development of interpretative and educational efforts can have a direct, indirect, and cumulative effect on the preservation of existing infrastructure by increasing awareness of their importance in the public's mind, potentially reducing misuse and vandalism. Existing vacant infrastructure reused in community-based interpretive and educational efforts, training, and demonstration will have the effect of reducing the amount of vacant infrastructure and could reduce existing deferred maintenance costs.

Climate Change - Infrastructure

Increases in extreme weather events may increase damage to facilities and structures, reduce tourist access in some areas, and increase the need for road repairs. The projected increase in the dry weather periods will reduce the effects of rain erosion on the roads, possibly reducing maintenance needs. At the same time, the increase in intensity of severe weather systems such as hurricanes or heavy rain events will directly affect the infrastructure by landslide damage, water erosion, wind damage, damage by fallen debris and destabilization of soils. The projected increases in urban area temperatures during the dry season and summer months might translate in higher visitation to the Forest by people looking for recreation in cooler areas with shade and accessible water like those provided by El Yunque. If visitation increases that will directly increase the wear and tear on the infrastructure, roads and trails, as well as the likelihood of intentional vandalism activities.

Recreation - Infrastructure

Developing recreational opportunities in the lower part of the Forest will have the effect of reducing the strain on the existing recreational infrastructure located on the upper part of the Forest (Road 191 Corridor). The proposed evaluation of infrastructure investments could directly affect the maintenance and development of existing and new infrastructure by identifying partnerships, volunteering, and funding to support infrastructure management.

Cultural Resources - Infrastructure

The proposed reduction of deferred maintenance of existing historic infrastructure will have a direct effect of improving the condition of many of the properties. The proposed restoration and reuse of existing historic infrastructure will have the effect of reducing the amount of vacant infrastructure and reduce operational and maintenance costs.

Management Areas - Infrastructure

Management Area 2 (El Yunque/Yokahu Zones)

The restoration and management of recreation infrastructure in those areas will have a direct effect of maintaining preserving existing infrastructure. The interpretation of the historic properties in that area could have a direct and cumulative effect of reducing damaging practices by the public such as vandalism. The increase in visitation to the resources in that area could have the indirect effect of increasing vandalism and wear and tear on the infrastructure.

Management Area 3 (Communications)

The proposed removal of communications facilities from the east end of El Yunque Peak Site will have the effect of removing infrastructure, reducing maintenance and operational costs at El Yunque Peak. The proposed interpretation of the cultural resources there will directly enhance its historical context and the public understanding of historic infrastructure which could have the indirect effect of reducing vandalism and misuse.

Management Area 4 (Community Interface Resource Management Area - CIRMA)

Recreation relocation to this area will reduce stress on the upper Forest infrastructure, including roads, trail and facilities.

Management Area 5 (Wilderness)

The wilderness area has the effect of increasing the difficulty and costs involved in maintaining and repairing the existing trails through the wilderness.

Management Area 9 (Scenic Byway 186)

The proposed creation of the scenic byway management area as outlined will require a higher level of maintenance, stewardship, and interpretation of the historic sites along the route. The increase in maintenance and interpretation will help improve and monitor the conditions of the resources, which have been neglected to a higher degree than similar resources along Road PR-191. This will have an effect on the resource by increasing public awareness of the resources importance and has the potential to increase visitation to a number of historic structures along the route. The increase in visitation on the area might increase the likelihood vandalism on the sites. It will also have the cumulative effect of wear and tear on the sporadically used historic road, bridges and related features.

Geographic Areas - Infrastructure

North and Southwest Geographic Areas

The proposed increased interconnection of existing trail to points of access within the municipalities will likely have the indirect effect of increasing accessibility to the Forest and maintenance costs due to wear and tear on the existing historic trails. The proposed development of collaborative efforts with the community could have the effect of increasing the availability of partnerships, personnel and external funding for maintenance and use of existing infrastructure.

Alternative 3

The effect of the resources' desired future conditions are the same as in alternative 2, with the following differences.

Extension of Wilderness to Research Natural Area - Infrastructure

The recommended extension of the wilderness area to encompass the Baño de Oro Research Natural Area will potentially have the effect of increasing maintenance costs of the infrastructure located within it due to the constrains imposed by wilderness regulation.

Facilities and Transportation - Infrastructure

The proposed change of trail care level to maintenance levels will have an effect on the maintenance of many of the trails. The reduction of maintenance will affect the conservation of the trail system.

Management Areas - Infrastructure

Management Area 2 (El Yunque/Yokahu Zones)

The restoration and management of recreation infrastructure in those areas will have a direct effect of maintaining and preserving existing infrastructure. The interpretation of the historic properties in that area could have a direct and cumulative effect of reducing damaging practices by the public such as vandalism. The increase in visitation to the resources in that area could have the indirect effect of increasing vandalism and wear and tear on the infrastructure.

Management Area 3 (Communications)

The proposed removal of communications facilities from the east end of El Yunque Peak Site will have the effect of removing infrastructure, thus reducing maintenance and operational costs at El Yunque Peak. The proposed interpretation of the cultural resources there will directly enhance its historical context and the public understanding of historic infrastructure which could have the indirect effect of reducing vandalism and misuse.

Management Area 5 (Wilderness)

The wilderness area has the effect of increasing the difficulty and costs involved in the maintenance and repairs of the existing trails through the wilderness.

Management Area 7 (Baño de Oro Proposed Wilderness)

The creation of and additional wilderness area will have the effect of increasing the difficulty and costs involved in the maintenance and repairs of the existing trails through the wilderness.

Geographic Areas - Infrastructure

North and South Geographic Areas

The proposed increased interconnection of existing trails to points of access within the municipalities will likely have the indirect effect of increasing accessibility to the Forest and maintenance costs due to wear and tear on the existing historic trails. The proposed development of collaborative efforts with the community could have the effect of increasing the availability of partnerships, personnel and external funding for maintenance and use of existing infrastructure.

3.6 Other Required Disclosures

3.6.1 Environmental Justice

Under legislation and presidential mandates, the Federal government requires “environmental justice” in all its agencies to ensure fair access to all in environmental regulations and decision making. Environmental justice is the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The goal of environmental justice is for Federal agencies to identify impacts that are disproportionately high and adverse with respect to minority or low-income populations and identify alternatives that will avoid or mitigate those impacts. The Forest Service has specifically adopted this into its new planning rule. This is an opportunity for the Forest to address this issue and have a better connection with underserved populations.

El Yunque has a conglomerate of unique qualities, one of the most significant are the communities that surround it. These communities can be identified within the framework of environmental justice qualities as described in the Planning Rule (2012). The communities in the region surrounding the Forest have the

lowest income per capita in the nation. Youth programs are greatly needed to give equal opportunities in land use within National Forest lands and the communities that surround the Forest are mostly (all) Puerto Rican, a minority at a national level. Although some interaction with the Forest and the communities have existed in the past; historically they have not had a participative relationship with the Forest (underserved). These are precisely the traits that the new Forest Planning Rule (2012) describe as the types of populations that we should be actively engaging to encourage and enable their participation in planning processes regarding forest management activities and use of forest resources as part of seeking environmental justice. As the planning rule states in its preamble:

> The Department recognizes the need to engage a full range of interests and individuals in the planning process and the responsibility to promote environmental justice. To encourage wide-ranging participation, the final rule retains the requirement for the responsible official to seek participation opportunities for traditionally underrepresented groups like youth, low-income populations, and minority populations.
>
> The Department added requirements in §§ 219.8 and 10 to take into account opportunities to connect people with nature when developing plan components to contribute to social and economic sustainability and for multiple uses, including recreation, in addition to the requirements for outreach to youth, low-income, and minority populations included in this section. Specific issues regarding recreation access on a unit will be addressed at the local level during the planning process.
>
> Environmental Justice […]
>
> …While national level impacts are not expected to be disproportionate, yet-to-be-identified adverse impacts may be possible on a regional or local scale at the unit planning level. Differences in national level effects and regional/local level effects are the result of uneven distribution of minorities, low-income populations, and variations in regional, cultural, or traditional use, and differences in local access to resources. Impacts on the national forest level will be further examined at the unit level, including NEPA analysis for plan development, plan revision, or plan amendment and site-specific projects.
>
> The participation efforts required by the final rule have significant potential to reach and involve diverse segments of the population that historically have not played a large role in National Forest System planning and management. Section 219.4(a) requires that when developing opportunities for public participation, the responsible official shall take into account the discrete and diverse roles, jurisdictions, responsibilities, and skills of interested and affected parties as well as the accessibility of the process, opportunities, and information. The responsible official is required to be proactive and use contemporary tools, such as the Internet, to engage the public, and share information in an open way with interested parties.
>
> Requirements of § 219.4 to consider accessibility and requirements to encourage participation by youth, low income populations, and minority populations may improve environmental justice outcomes.

El Yunque National Forest has, during all stages of the planning process, addressed youth, low income populations, minority populations, as well as underserved communities to promote and develop further accessibility to the Forest lands and Forest collaboration initiatives. At the assessment stage, the Forest developed community meetings and activities with communities that had not been engaged before. During the planning process (in the need for change, the proposed action as well as the development of the alternatives) the Forest met with these sectors of the public for their input and to establish a

relationship for future engagement and collaborative opportunities within the realms of environmental education, recreation, access, tourism, conservation, etc. This became a historic opportunity for the Forest to not only address the Forest-wide issues but to contribute to the broader landscape as it seeks Environmental Justice for its local communities.

3.6.1.1 Affected Environment

The census data presented in the Economic and Social Environment sections describes the demographic conditions of communities surrounding the Forest, which is essential to understanding this section. The previous sections assessed the social and economic conditions and demographic trends in order to establish a baseline understanding of how the Forest contributes to social and economic sustainability of local beneficiaries and the general public.

The nine municipalities surrounding El Yunque extend over 336 square miles (about 10 percent of Puerto Rico's total area) (table 3-32). They encompass coastline, plains, hills, and mountains within a complex matrix of land cover and use (Gould et al. 2012). El Yunque accounts for 13 percent of their total combined area. Eight municipalities have some of their land base within the boundaries of El Yunque, ranging from less than 1 percent of the total area of Juncos to more than 33 percent of Río Grande (table 3-32). Humacao is the only municipality in El Yunque Region with no land falling within the National Forest boundary; however, its ecological and socioeconomic connections are an important part of the relationship this municipality possesses with the Forest.

As the population around the Forest continues to shift in terms of number, age structure, and gender distribution, as predicted in the near term at least, changes are likely to occur in individual and community values, uses, needs, and demands on public lands.

Personal and family income are key indicators of the overall economic conditions or well-being of a community and are important considerations in public land management decisions, particularly where these decisions may affect income opportunities. For more detailed information please see the socioeconomic section.

Per capita and median family incomes in current dollars (value at the time earned/received) have increased across Puerto Rico and within the study area for several decades. However, to accurately compare income over time, summary measures (medians, means, etc.) should be adjusted to account for changes in the cost of living (i.e., inflation) (U.S. Census Bureau 2013). When adjusted for inflation, income across Puerto Rico and within the area around El Yunque have only modestly increased since 1970 (0.66 percent per year and 0.71 percent per year from 1970 to 2010, respectively) (figure 3-9). Ultimately, while median family and per capita income have increased in the study area and across Puerto Rico over the past several decades, they have only modestly outpaced the rate of inflation. This slow growth in personal and family income is in large part a reflection of the sluggish Puerto Rican economy that has struggled for decades under mounting government debt and the high costs of doing business on the island (Cohn et al. 2014; Federal Reserve Bank of New York 2012).

Poverty levels are another important indicator of community well-being. In 2010, about 44.2 percent of the population in the region was living below the poverty level as defined by the U.S. Census Bureau (2015). Fairly significant intraregional differences existed, with Fajardo and Río Grande having the lowest poverty rates (42.1 percent), and Naguabo demonstrating the highest (52.6 percent). The percentages of people living below the poverty level generally have been declining throughout the region since 1970 at least, with the exception of Ceiba, which increased to 43.1 percent in 2010 from 38.6 percent in 2000 (Oficina del Censo 2015) (figure 3-10). Despite general improvements, poverty in the region and across Puerto Rico occurs at significantly higher rates than in the U.S. For example, the

percent of people living in poverty in the region surrounding El Yunque in 2010 was nearly three times the national rate (14.3 percent) and almost double that of Mississippi (21 percent), which had the highest state-wide poverty rate in the U.S. in 2010 (U.S. Census Bureau 2015).

Children represent a disproportionate share of the poor in El Yunque region, as throughout Puerto Rico. In 2013, children (less than 18 years of age) represented less than 25 percent of the total population in the region, but they represented more than 33 percent of the population living below the poverty level (figure 3-10). Of the estimated 71,912 children living in the region in 2013, 56 percent were considered to be living below the poverty level (U.S. Census Bureau 2015).

Overall, while the populations surrounding El Yunque are living longer and spending more years in formal education, which enhances the knowledge and skills available for responding to demands and changes in the social and natural environment, per capita and family income have only modestly outpaced inflation, and poverty remains high, particularly among children. Limited growth in income and persisting poverty among a large segment of the population are signs of social vulnerabilities and may be indicators of large segments of society that are being "left behind" or at risk of further decline. Low income and high poverty rates also often result in greater demands for public services and resources, including from public lands. Therefore, it is important for management decisions to account for how these community members or segments of society may be affected by changes in management direction and Forest use.

In conclusion, although educational characteristics reflect a more educated population than in past years the poverty levels are extremely high. These ingredients point to shifting conditions around the Forest but it also points to future possibilities for land use and socioeconomic development. The varied socioeconomic conditions surrounding the Forest could result in a great opportunity to have positive impact on the broader landscape and Forest-wide conditions. The revised Forest Plan offers resources such as recreation, water, cultural resources, environmental education, vegetation, and forest products in a sustainable use focus that could also be a contribution to the socioeconomics of the region.

Effects Common to All Alternatives

While there are no populations in the plan area that will experience significant, adverse human health impacts or environmental effects due to management actions proposed under any of the alternatives, alternative 2 or 3 provide for more opportunities for collaboration and environmental justice and in turn socioeconomic development in the region more than alternative 1.

Under all alternatives, the Forest will continue to provide benefits to local beneficiaries and the general public which enhance their economic opportunities for employment and earning income. Detailed information on the Forest contribution in employment can be found in the "socioeconomic" section.

Under all the alternatives, the Forest will continue to provide benefits to local beneficiaries and the general public which enhance their quality of life through contributions to well-being, health and safety, water resources, recreation, traditional and cultural resources and many other important resources.

Alternative 1

This alternative does not address environmental justice within its land use, nor any resource-driven activities to address environmental justice. For instance; collaboration is not proposed in alternative 1 and therefore activities that include collaboration with surrounding communities is not considered. This would limit Forest activities that could address the needs of low-income populations, underserved populations, and youth and minorities populations surrounding the Forest.

Under this alternative the Forest will continue to provide resources as the other alternatives, but with less accessibility to certain communities (underserved), considering it will not consider management such as the Community Interface Resource Management Area (CIRMA) in alternatives 2 and 3.

This alternative would have an indirect adverse effect on the surrounding landscape because limiting engagement with the public and local communities would not foster socioeconomic development within the Forest and expanding this outside the Forest as well.

This alternative would not foster relationships with the communities and management strategies of the Forest would not consider the populations which the new planning rule requires, in terms of environmental justice.

Alternative 2

Alternative 2 considers collaboration, and environmental justice in its development and content of Forest land management; as well as land use management that would impact the broader landscape.

This alternative would foster or consider the socioeconomic conditions of the surrounding communities (underserved, youth, minorities, low-income population) for its land use. For instance, the Forest in this alternative could develop collaboration opportunities for socioeconomic development in sectors of the Forest accessible to communities that previously did not have accessibility to Forest lands. The Community Interface Resource Management Area is Forest lands that would serve as lands to develop activities such as forest products (agroforestry), recreation, environmental educations, among other activities that could be developed with these communities.

This alternative could address socioeconomic issues the region is facing through the development of socioeconomic opportunities within the Forest and within the broader landscape when collaboration opportunities arise.

This alternative would foster long-term relationships with the communities and the management strategies of the Forest would consider populations in new planning rule which are deemed important to address issues arising in environmental justice.

Alternative 3

This alternative would have the same effects as alternative 2, although with geographical differences considering management areas such as the scenic by-way management area would not exist and therefore the opportunities for furthering access and socioeconomic development could be limited.

While there are no populations in the plan area that will experience significant, adverse human health impacts or environmental effects due to management actions proposed under any of the alternatives, alternatives 2 or 3 will provide for more opportunities for collaboration and environmental justice (and in turn more socioeconomic development opportunities in the region) than under alternative 1.

3.6.2 Relationship of Short-Term Use and Long-Term Productivity

The relationship between the short-term uses of the environment and the maintenance and enhancement of long-term productivity is complex. Short-term uses are generally those that occur irregularly on parts of the Forest, such as fixing the trail in a recreational site, a one day special activity in the forest, etc. Long-term uses refer to a period greater than ten years; for example use of a certain area for permits of communication towers and facilities.

Productivity is the capability of the land to provide market and amenity outputs and values for future generations. Soil and water are the primary factors of productivity and represent the relationship between short-term uses and long-term productivity. The quality of life for future generations would be determined by the capability of the land to maintain its productivity. By law, the Forest Service must ensure that land allocations and permitted activities do not significantly impair the long-term productivity of the land.

All the alternatives considered for the forest, including the preferred alternative (alternative 2), incorporate the concept of sustained yield of resource outputs while maintaining the productivity of all resources. The specific direction and mitigation measures included in the forest-wide management standards ensure that long-term productivity would not be impaired by the application of short-term management practices.

Each alternative considered in the Plan was analyzed, to ensure that the minimum standards could be met. Through this analysis, long-term productivity of the National Forest's ecosystems is assured for all alternatives.

As stated earlier, the effects of short-term or long-term uses are complex, and depend on management objectives and the resources that are emphasized. No alternative would be detrimental to the long-range productivity of El Yunque National Forest.

The effects of implementing the Forest Plan will be monitored at the Forest level. Broad-scale monitoring will focus on changes in the environment that may affect resources on El Yunque. Evaluation of the monitoring data collected will determine if standards for long-term productivity are being met, or if management practices need to be adjusted. A monitoring design is included in chapter 4 of the Forest Plan.

3.6.3 Irreversible and Irretrievable Effects

Irreversible and irretrievable commitments of resources are normally not made at the programmatic level of a Forest Plan. Irreversible commitments are decisions affecting non-renewable resources such as soils, minerals, plant and animal species, and cultural resources. Such commitments of resources are considered irreversible because the resource has been destroyed or removed, or the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense. While a Forest Plan can indicate the potential for such commitments, the actual commitment to develop, use, or affect non-renewable resources is normally made at the project level.

Irretrievable commitments represent resource uses or production opportunities, which are foregone or cannot be realized during the planning period. These decisions are reversible, but the production opportunities foregone are irretrievable. An example of such commitments is the allocation of management prescriptions that do not allow timber harvests in areas containing suitable and accessible timber lands. For the period of time during which such allocations are made, the opportunity to produce timber from those areas is foregone, thus irretrievable.

The leasing of a resource or the increase of water extraction from the Forest is not made solely due to a request of a citizen, or an agency. The available information, the circumstances, the sites considered and additional technical information needs to be evaluated before making any decision. Actual extraction of a resource could be considered an irreversible commitment, especially for non-renewable resources, like minerals. Any site-specific decisions to actually permit an extraction will occur following receipt of an application for permit for that extraction or activity.

3.6.4 Effects on Wetlands and Floodplains

No significant adverse impacts on wetlands or floodplains are anticipated. The plan integrates the definition of a functional wetland considering that all plant communities located above the 600-meters elevation line at El Yunque, above the cloud condensation level, are wetland communities. The 600-meter elevation boundary determines where clouds will form and, thus, where the cloud forest community begins (Harris et al. 2012).

Wetland values and functions would be protected in all alternatives through the implementation of the riparian management zones and following best management practices for forestry. Under the requirements of Executive Order 11990 and Clean Water Act, Section 404, wetland protection would be provided by ensuring that new construction of roads and other facilities would not have an adverse effect on sensitive aquatic habitat or wetland functions. In addition, wetland evaluation would be required before land exchanges or issuance of special-use permits in areas where conflicts with wetland ecosystems may occur.

Mitigation measures have been designed to conserve riparian zones and protect floodplains through the direction in the rivers and streams ecosystems. The direction of this ecosystem is embedded in all other ecosystem groups. Executive Order 11988 also requires site-specific analysis of floodplain values and functions for any project occurring within the 100-year floodplain zone, and prior to any land exchange involving these areas. Effects to wetlands are also discussed through the document especially in Section 3.3 “Physical Environment,” 3.3.5 “Water and Watersheds,” 3.4 “Biological Environment,” 3.4.1 “Ecological Systems,” of this final EIS.

Protective measures for riparian zones include the delineation of riparian management zones on perennial and intermittent streams. Management activities within the riparian management zone must comply with the best management practices and any other water quality regulations. Floodplains would be managed by locating critical facilities outside of floodplains or by using structural mitigation measures. Further protections are provided in Forest-wide standards for management of ephemeral stream zones.

3.6.5 Unavailable or Incomplete Information

El Yunque National Forest has used the best available scientific information and state-of-the-art analytical tools to evaluate management activities and to estimate their environmental effects.

However, gaps will always exist in our knowledge. The Council on Environmental Quality regulations discuss the process for evaluating incomplete and unavailable information (40 CFR 1502.22 (a) and (b)). Incomplete or unavailable information is noted in this chapter for each resource, where applicable.

After hurricane María, many of its effects, especially in the socioeconomic aspects, are still unknown, though much monitoring is taking place.

Forest Plan monitoring is designed to evaluate assumptions and predicted effects. Should new information become available, the need to change management direction or amend the Forest Plan would be determined through the monitoring and evaluation process.

Chapter 4. List of Preparers and Distribution

The following individuals contributed to this final environmental impact statement.

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Email List of Government, Agencies, Organizations, Academic Institutions and Individuals Receiving El Yunque Revised Plan and Final Environmental Impact Statement

Municipalities

Canóvanas

Ceiba

Fajardo

Las Piedras

Luquillo

Naguabo

Rio Grande

Juncos

Humacao

Non-government Organizations

Acampadores De Puerto Rico

Programa De Café De Sombra

Fondos Unidos De PR

Amigos De El Yunque

Alianza Ambiental De PR

Fideicomiso De Conservación De PR

Ciudadanos Pro Bosque San Patricio

American Red Cross

Amigos De Los Animales

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Servicio De Extensión Agrícola 4H

Fideicomiso De Conservacion E Historia De Vieques

Coalición Pro-Corredor Ecologico Del Noreste

Comité Yabucoeños Pro-Calidad De Vida

Asociación De Agricultores De PR

Producir, Inc.

Comité Pro Acceso A Playas De Rio Grande, Inc.

Comité Pro Conservación Ecológica Y Ambiental

Comité Pro Yabucoeños Pro Calidad De Vida

Consejo Legal En Defensa Del Ambiente

Re-Foresta

Ciudadanos Del Karso

Sociedad Puertorriqueña De Planificación

Waterkeepers

Frente Unido Ambiental

Fundación Enrique Marti Coll

Fundación Sufrider De PR

Centro De Información, Investigación & Educ Social

Corp. Conservation of the San Juan Bay Estuary

Colegio De Ingenieros Y Agrimensores

Ciencia PR

Sierra Club

Org Boricuá De Agricultura Ecoorgánica

Instituto Universitario Desarrollo De Comunidades

Comité Pro Rescate Y Desarrollo De Vieques

Programa Del Estuario De La Bahía De San Juan

Arrecifes Pro Ciudad

Coralations

Scuba Dogs Society

Casa Pueblo

Eco-Ambiente, Inc.

Misión Industrial De PR, Inc.

Movimiento Agua Para Todos

Boricua

Sociedad De Historia Natural

Girls Scout Council

Centro De Acción Ambiental, Inc.

Boy Scout Council

Coalición Playa Para Todos

Proyecto Coquí

Museo De Arte Contemporáneo

Comité Pro Mejor Ambiente Y Salud

Red Caribeña De Varamientos

Sociedad Espeleológica De PR, Inc

Canal Luis Peña

Fundación Puertorriqueña De Conservación

Nuestra Madera

Rural Opportunities

Sociedad Ornithologica Puertorriqueña

Arrecifes Pro Ciudad

Centro Para Conservación Del Paisaje

Pare Del Este

Urukuda Guakia Taina Ke, Inc.

Tropic Ventures Sustainable Forestry Project

Mahogany for the Future, Inc.

Peces

Sea Grant

Outfitters and Guide Companies

Native Tours and Expediciones Nacionales

Adventours

Enchanted Island Eco Tours, Inc.

Atlantic San Juan Tours

Autobuses de Puerto Rico

Bracero Limousine, Inc.

Castillo Watersports, Inc.

Cintron Tour Services

COPLADET

Dorado Transportation Cooperative

The Exclusive

Explorer Adventure

Federación de Taxistas de Puerto Rico

Go Happy Tours

Hillbilly Tours

Net Transporation, Inc.

Northeast Coast, Inc.

Palmas Transportation Corp.

Rafael Quiles

Rico Suntours

RM Transport

San Juan Tour Guides

Luis Sanchez Diaz

The Excursionists Association, Inc.

Tour Coop de Puerto Rico

Travel Services, Inc.

United Tour Guides Cooperative of Puerto Rico

Vany Tours

Professors, Students and Organizations from Academic Institutions in Puerto Rico

Ana G. Méndez University System
Universidad De Puerto Rico
UPR Carolina
UPR-Río Piedras
UPR-Bayamón
UPR-Arecibo
UPR-Mayaguez
UPR-Humacao
Ites-UPR
UPR-Aguadilla
UPR-Cayey
Universidad Interamericana
Universidad Politécnica De PR
Universidad Del Turabo
National University College
Universidad Metropolitana

Professors, Students and Organizations from Academic Institutions Outside of Puerto Rico

University of New Hampshire
Michigan State University
Syracuse University
University of Washington
Frostburg State
North Carolina State University
University of Georgia
Rutgers University
University of Missouri

Puerto Rico Government Agencies

Regulations & Permits Administration
Puerto Rico Tourism Company
Solid Waste Authority
Puerto Rico Ports Authority
Puerto Rico Electric Power Authority
Puerto Rico Aqueduct and Sewer Authority
Puerto Rico Planning Board
Department of State of Puerto Rico
Roosevelt Road Base Development Authority
State Historical Preservation Office
Department of Transportation and Public Works
Department of Corrections-El Zarzal
Puerto Rico Film Commission
Department of Agriculture of Puerto Rico
Department of Natural and Environmental Resources
National Parks Company of Puerto Rico
Environmental Quality Board of Puerto Rico
State Police of Puerto Rico
Puerto Rico Land Authority
Institute of Puerto Rican Culture
Puerto Rico Department of Education

Federal Government Agencies

Alcohol, Tobacco, Tax & Trade Bureau
Natural Resources Conservation Service
Department of Homeland Security
USDA Animal & Plant & Plant Health Inspection Service-APHIS

OSHA

NOAA

National Park Service: San Juan National Historic Site

U.S. Department of Justice

U.S. Geological Survey

Environmental Protection Agency

U.S. Army Corps of Engineers

U.S. Immigration and Citizenship Services

Small Business Administration

U.S. Fish & Wildlife Services

Internal Revenue Services

U.S. Customs & Border Protection

Veteran Administration

Social Security Administration

Federal Highway Administration-FHWA

U.S. Department of Housing & Urban Development

Federal Aviation Administration

U.S. Army Ft. Buchanan

Elected Officials

Members of U.S. Congress

Resident Commissioner

Hon. Jennifer González

Governor of Puerto Rico

Hon. Ricardo A. Roselló Nevares

Representatives and Senators of PR

House of Representatives

Hon. Carlos Méndez Nuñez (president)

Hon. Angel Bulerin Ramos

Hon. Angel R. Peña Ramírez

Hon. Javier A. Aponte Dalmau

Hon. Narden Jaime Espinosa

Hon. Jesus Santa Rodriguez

Senate of Puerto Rico

Hon. Thomas Rivera Schatz (President)

Hon. Luis Daniel Rivera

Hon. Nayda Venegas Brown

Hon. Eric Correa Rivera

Hon. Pedro A. Rodríguez

Hon. Jose Luis Dalmau

Hon. Jorge Suarez Cáceres

Hon. Miguel Laureano

Members of special committees

Hon. Cirilo Tirado

Hon. Ramón Ruiz Nieves

Individuals

Nando Acosta

Eduardo Agostini

Monica Agosto

Albert Aguirre

Rafael Alvarez

Lisandra Andina

Jose M. Aponte

Jose F. Aponte

Jose Ardren

Y. Baez

Roberto Bello

Jose Benitez

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Angie Colon

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Rupert Cosme
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Rafael Gomez
Victor H. Rivera
Carmen Hurtado
Fernando Jimenez
Diana Ju
Miriam La (Lamora)
Antonio Lizardi
Manuel Leal
Miguel Leon
Arturo Lizardi
Victor L. Lleras
Ricky Lopez
Eduari Navarro
Brad Mann
Joanina Martinez
Jose E. Martinez
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Adenis Millan
Erik P. Moccabez
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Nemesis Ortiz
Lenis Oropeza
Ashley Perez
Debora Perez
Esmeralda Perez
Leslie Perez
Migdalia Perez Plaza
Ramon Perez
Jimmy Pina
Stephen Porder
Geraldo Quiñones
Melanie Quiñones
Abimael Reyes
Marisa Reyes
Yolanda Rios Carrasquillo

Luis Jorge Rivera Herrera
Anamarie Rivera
Carlos Rivera
Edwin Rivera
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Harold Rivera
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Julio Santiago
Ileana Sewpershad
Robert Talavera
Angel Torres
Jose A Torres
Soraya Torres
Miguel Treviño
Carlos Vega
Frank Wadsworth
Richard Washburn
Peter Weaver

Plan Revision EIS Mailing List, Required Federal Agencies

Director, Planning and Review/Advisory Council on Historic Preservation, Washington, DC 20004
Deputy Director, APHIS, PPD/EAD; Riverdale, MD 20737-1238
Rural Utilities Service; Washington, DC 20250-1548
National Environmental Coordinator, NRCS; Washington, DC 20250
Acquisitions & Serials Branch; Beltsville, MD 20705
Habitat Conservation Division; St. Petersburg, FL 33701
U.S. Army Corps of Engineers; Atlanta, GA 30303-8801
U.S. EPA, Region 2; New York, NY 10007-1866
U.S. Coast Guard, Commandant CG-47; Washington, DC 20593
Regional Director, Southern Region, FAA; East Point, GA 30320
PR Division Federal Highway Administration, Division Administrator; San Juan, PR 00918
Director, NEPA Policy & Compliance, DOE; Washington, DC 20585
NOAA Office of Policy and Strategic Planning; Washington, DC 20230
Director OEPC; Washington, DC 20240
Federal Energy Regulatory Commission; Washington, DC 20426

References

Clean Air Act, 42 U.S.C. 7401-7671q, July 14, 1955, as amended. This Act, as amended, is known as the Clean Air Act of 1970. The amendments made in 1970 established the core of the clean air program. The primary objective is to establish Federal standards for air pollutants. It is designed to improve air quality in areas of the country which do not meet Federal standards and to prevent significant deterioration in areas where air quality exceeds those standards.

36 Code of Federal Regulation (CFR) Part 219; National Forest System Land Management Planning. This planning rule sets forth process and content requirements to guide the development, amendment, and revision of land management plans to maintain and restore National Forest System (NFS) land and water ecosystems while providing for ecosystem services and multiple uses.

36 Code of Federal Regulation (CFR) Part 294; Roadless Area Conservation. The intent of this final rule is to provide lasting protection for inventoried roadless areas within the National Forest System in the context of multiple-use management.

40 Code of Federal Regulation (CFR) 1502; Environmental Impact Statement. The primary purpose of an environmental impact statement is to serve as an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal Government.

40 Code of Federal Regulation (CFR) 1508; Terminology and Index. This Code of Federal Regulation has the intent of providing a list of terms and their meaning according to the Federal Government.

Endangered Species Act (ESA) of 1973, as amended; P.L. 93-205, 16 U.S.C. 1531 et seq. Protects threatened, endangered, and candidate species of fish, wildlife, and plants and their designated critical habitats. Under this law, no Federal action is allowed to jeopardize the continued existence of an endangered or threatened species. The ESA also requires consultation with the USFWS and the National Marine Fisheries Service and the preparation of a biological assessment when such species are present in an area that is affected by government activities.

Forest Service Handbook (FSH) 1909.12; Land Management Planning Handbook Chapter 70; Wilderness Evaluation. The primary function of the identification and inventory step is to comprehensively identify "all-lands" that may have wilderness characteristics within the plan area, using a transparent process. Lands included in the inventory will be carried forward for further evaluation.

Forest Service Handbook (FSH) 2309.18; Trails Management Handbook. Objectives of this handbook include: to provide trails that meet their trail management objectives, are consistent with the applicable land management plan, provide opportunities for satisfying recreation experiences, harmonize with and provide opportunities for enjoyment of the National Forest or grassland setting, and minimize maintenance costs.

Forest Service Handbook (FSH) 2300 – Chapter 2350; Trail, River, and Similar Recreation Opportunities. Objectives of this chapter include: to provide recreation-related opportunities for responsible use of national forests and national grasslands, and to mitigate adverse impacts of recreational uses on natural, cultural, and historical resources and on other uses through education, outdoor ethics programs, and on-the- ground management, including law enforcement and restoration.

National Environmental Policy Act of 1969 (NEPA), as amended; Public Law 91-190; 42 U.S.C. 4321 et seq. Requires Federal agencies to utilize a systematic approach when assessing environmental impacts of government activities. Establishes the use of environmental impact statements. NEPA proposes

an interdisciplinary approach in a decision making process designed to identify unacceptable or unnecessary impacts on the environment.

National Forest Management Act Of 1976; 16 U.S.C. 1600(note). This act recognizes that the management of the Nation's renewable resources is highly complex and the uses, demand for, and supply of the various resources are subject to change over time.

The Wilderness Act of 1964; Public Law 88-577; 16 U.S. C. 1131-1136. Established the National Wilderness Preservation System composed of federally owned areas designated by Congress. The act also stipulates these lands be administered for the "use and enjoyment of the American people in such manner as will leave them unimpaired for future use as wilderness and preserve their untouched character.

Wild and Scenic Rivers Act; U.S.C. 1271-1287. The purpose of this Act is to implement this policy by instilling a national wild and scenic rivers system, by designating the initial components of that system, and by prescribing the methods by which and standards according to which additional components may be added to the system from time to time.

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Appendix A: Public Involvement

Planning began with an assessment phase, where an Interdisciplinary (ID) Team, made up mainly of staff, managers, contractors and scientists, was organized. During the assessment phase, the ID Team evaluated all the existing information, data and resources in the planning area. Through the use of the ID team's expertise and the best available scientific information, the Forest identified over 125 key findings that spanned social, economic and ecological issues as well as gaps of information. An exercise of establishing priorities helped point out the 25 most important -or major- key findings. These 25 major key findings were used to develop the Need for Change, where the Forest evaluated which findings were not addressed in the 1997 Forest Plan and support the need for a Forest Plan Revision.

In September 2012, the Collaboration Cadre and Environmental Policy Solutions (EPS), an NGO that began the Forest collaboration process during the assessment phase, conducted a series of listening sessions to hear community members, stakeholders, and employees' concerns, needs and desires for future forest conditions. Four public meetings were held in communities around the Forest for the public to learn more about the planning process and to provide comments on issues they felt were important in managing the Forest and to include in the Plan. An interactive mapping exercise helped participants identify locations where uses, issues, or opportunities occur in and around the Forest. In December 2012, about 100 stakeholders including representatives from communities, agencies, organizations and Forest Service employees attended a workshop to discuss collaboration and learn more about the collaborative process and their level of interest to participate in the planning effort.

As a result of this two day workshop, the citizens' collaboration committee (CCPP), made up of members of the community and stakeholders was assembled to work with the Forest Service to assist in public involvement and collaboration on issues throughout the planning process. The CCPP continued to support the Forest in the planning process and will assist in the new Forest Plan implementation. This group met every month with staff to be briefed on the progress of the plan and, based on the plan's progress, coordinate to support the staff and begin preparations and outreach on the Forest Plan and implementation.

Community meetings were held to explain the Need for Change and present the major key findings and planning problems. The meetings were held by the Centro para la Conservación del Paisaje, a non-government organization, in different municipalities in El Yunque region. During these meetings, concerns regarding additional designations in the Forest were expressed regularly. Also, recommendations and support for more collaborative conservation, economic development and educational efforts was articulated. All arguments presented supported the need for a new Forest Plan. Comments from the public, along with the 2014 Forest Plan Assessment, shaped the Proposed Action considering the need for change. The Proposed Action was made to address planning, collaborative, sustainability, social, economic and ecological needs. The Proposed Action was presented in community meetings, as well as focus groups, composed of different government agencies and interested parties such as municipal planners, protected area managers, outfitters and tour operators.

By evaluating input from focus groups, community meetings and more in-depth analysis of the need for change, two alternatives for the Forest Plan were made, with the no-action as a third alternative. These alternatives were presented in different community meetings as well, where much support was expressed for alternative 2, which is the preferred alternative. Based on comments from Forest Service personnel, the public, other agencies and non-governmental organizations, the Planning Interdisciplinary Team (ID Team) developed a list of issues to address in this EIS.

Table A- 1 displays the collaboration meetings and events that were undertaken to ensure a wide variety of methods to collect comments that would've been used to develop alternatives.

Table A- 1. Public participation planning activities by date

Planning Outreach Activities	Date
Listening Sessions	September 18–19, 2012
Collaboration Workshop	December 5–6, 2012
Citizens Participatory Group Meetings	May 31, 2013 to current
2013 El Tinglar Festival	April 13, 2013
Ethnographic Appraisal	July–August 2013
Meeting with International Institute of Tropical Forestry	October 30, 2013
NEPA Workshop	December 3–4, 2013
Community Meetings 2014: Naguabo	January 28, 2014
El Yunque Employee Meeting	February 19, 2014
Community Meetings 2014: Fajardo 1	March 27, 2014
Community Meetings 2014: Las Piedras 1	April 3, 2014
2014 El Tinglar Festival	April 5, 2014
Community Meetings 2014: Río Grande	April 10, 2014
Scientific Forum on El Yunque at the Department of Natural Resources in San Juan, PR	May 8, 2014
Employee Meeting at El Yunque	August 13, 2014
Protected Areas Congress	August 28–29, 2015
Focus Group Meetings: Municipal Planners 1	September 18, 2014
Focus Group Meetings: Protected Area Managers	September 25, 2014
2014 El Yunque Festival	October 4–5, 2014
Focus Groups Meetings: Outfitters and Tour Operators	October 9, 2014
Focus Group Meetings: Municipal Planners 2	October 16, 2014
Community Meetings 2014: Fajardo #2	October 30, 2014
Department of Natural Resources Symposium, San Juan	November 6–7, 2014
Community Meetings 2014: Luquillo #2	November 13, 2014
Community Meetings 2014: Las Piedras #2	November 25, 2014
Forest Products Symposium	December 5, 2014
Community Meetings 2014: Canóvanas, Rio Grande #2	December 11, 2015
International Day of Forests in El Portal Visitor Center, El Yunque	March 21, 2015
SHPO Planning Presentation	March 26, 2015
2015 El Tinglar Festival	April 11, 2015
"Para La Naturaleza" Environmental Fair	April 18, 2015
Interamerican University Environmental Fair, Fajardo Campus	April 30, 2015
Community Meetings 2015: Las Piedras #3	June 23, 2015

Planning Outreach Activities	Date
Community Meetings 2015: Luquillo #3	June 24, 2015
Community Meeting 2015: Interamerican University Law School, San Juan	June 25, 2015
2015 El Yunque Festival	October 3, 2015
2016 International Day Of Forests in El Portal Visitor Center, El Yunque	March 19, 2016
2016 El Tinglar Festival	April 9, 2016
2016 "Para La Naturaleza" Environmental Fair	April 16, 2016

After the new Presidential and Puerto Rico commonwealth government administration changes in 2017, El Yunque staff reconvened with several key agencies including the PRDNER and the PR Planning Board. These agencies were briefed on the Forest Plan's progress and to make sure the planning direction still aligned with each of these agencies' purposes and goals. Concurrent with the release of the draft EIS, a notice of availability (NOA), published in the *Federal Register* (September 30, 2016) initiated the formal 90-day comment period on the draft EIS and proposed Forest Plan as required by Forest Service NFMA regulations 36 CFR 219. Only those individuals and entities who submitted substantive formal comments related to this plan revision during the opportunities provided for public comment were eligible to file an objection (36 Code of Federal Regulations (CFR) 219.53(a)). A total of 14 comment letters were received from different individuals, state, and federal agencies. None of the comment letters suggested the creation of a new alternative or to discard alternative 2 (the preferred alternative), rather some improvements and clarifications were considered necessary to be made on said alternative.

Comments by the public on El Yunque National Forest DEIS and Proposed Forest Plan addressed a wide range of concerns but were largely focused on recreation opportunities, wildlife management and vegetation. Six individuals provided substantive comments on the Plan and DEIS. Puerto Rico Tourism Company provided no additional comments, in full support of the proposed action and DEIS. The letters received represent a total of 77 comments. We addressed all the comments received, including the non-substantive.

A brief summary of the comments received is as follows:

- Broad support for achieving the sustainable management of the current high level of developed recreation infrastructure and to continuing adapting to the stresses of high density recreational areas by dispersing recreational users to different parts of El Yunque National Forest.
- Broad support for contributing to the social and economic sustainability of the region through collaborative efforts, enhancing general forest management, environmental literacy and education and implementing the shared stewardship of small-scaled recreation development and small-scaled forest product areas.
- Concerns were expressed about the effects of human activities on flora and fauna. The forest is a protected area with high ecological value in Puerto Rico due to its size compared to the rest of the Island. The high population density, combined with intensive land and resource use increase the risk of invasive species introduction and dispersion.
- Concerns were expressed about the unknown immediate and long-term effects of the changing climate on the ecosystems services of El Yunque National Forest, such as water dynamics for both wildlife species and human use, possible forest type range changes, along with encouragement for continued research to improve understanding of this complex issue.

The following table describes subjects addressed in the comments:

Table A- 2. Total of comments per category

Category	No. of comments
Recreation	14
Wildlife	8
Vegetation	7
Communications Sites	7
Forest Products	6
Watersheds	5
Lands	4
Pests and Invasive Species	4
Wild and Scenic Rivers	3
Research	3
Hazardous Material	2
Planning	2
Collaborations	2
Education	2
Aquatic Ecosystems	2
Heritage/Cultural Resources	1
Research Natural Area	1
Scenic	1
Wilderness Area	1
Ecosystem Services	1
Climate Change	1
Total	77

Table A- 3. Individuals/organizations that sent comment letters

	Individual/ Position	Organization
1	Enrique Hernández Prieto	Individual Citizen
2	Rafael Nido Vázquez	Individual Citizen
3	Francisco Watlington Linares	Individual Citizen
4	Tamara Heartsill	Individual Citizen
5	Peter Weaver	Individual Citizen
6	Sheila Ward	Individual Citizen
7	Diana de Ju	Individual Citizen
8	Luis Rivera	Individual Citizen
9	Chief of Sustainability and Multimedia Programs Branch, Clean Air and Sustainability Division	Environmental Protection Agency (EPA), Region 2

	Individual/ Position	Organization
10	Acting Director	Puerto Rico Tourism Company, (PR Government public corporation)
11	Regional Environmental Officer	Department of Interior
12	State Historic Preservation Officer	SHPO, (PR Government)
13	Marimar Bonet	Individual Citizen
14	Manager of Environmental and Licensing Projects Department	PREPA (PR Electric Power Authority, Public Corporation)

The following section was organized into broader comment categories:

1. Ecological Sustainability and Diversity of Plant and Animal Communities
2. Social and Economic Sustainability
3. Multiple Uses

Ecological Sustainability and Diversity of Plant and Animal Communities

Comments under this category include concerns regarding climate change, vegetation composition and classification, at-risk species, invasive species and management strategies for these fore mentioned subjects.

1. Climate Change Response

1.1 Comment: Is the forest large enough to survive uncertain global warming changes? (5)

Forest Response: Based on the Forest Plan Assessment, changes in the climatic condition of Puerto Rico as well as El Yunque National Forest are expected. The changes in temperature and rainfall patterns that will affect Puerto Rico and the Forest are broad-scale in nature and have no relationship to the Forest size.

The impacts of extreme weather events, such as the hurricanes in 2017, have also been considered. Hurricanes in general are a natural stressor that is included in the analysis. The distiburance, vegetation defoliation, vegetation mortality, landslides, flooding, and other hurricane related changes in general are within the natural range of variability of ecosystems in the analysis. As is stated in the affected enviornment – Vegetation section, the hurricanes did not change the vegetation community types but rather changed the successional state and structure of plants within their natural range of variability.

Section 3.1.1 of the Forest Plan also addresses climate change response, which includes improved immediate and long-term resilience.

2. Long-term land management effects

2.1 Comment: Will any of the proposed management interventions (logging and borderline recreational activities) cause potential long-term damage? Will these activities fragment the forest boundary?

Forest Response: The Forest Plan makes no site-specific determinations. Vegetation restoration and recreational activities will be subject to site-specific analysis in which the long-term resource damage will be evaluated. There will be no Forest boundary fragmentation because the Plan procures continuous vegetation cover.

3. Terrestrial Ecosystem: Vegetation

3.1 Comments concerning the composition of the Forest's vegetation

3.1.1 Comment: Knowledge on ecological vegetation composition and ecological functions should be used to categorize the existing forest communities and ecosystems. (4)

3.1.2 Comment: The areas identified as "Plantation/Secondary Montane Wet Forest and Plantation/Secondary Submontane Moist Forest" are not actively managed Plantations, nor are they the only secondary forests in El Yunque. Many of the other forest types described/named contain and are Mature Secondary forests. Therefore, the currently used naming convention may lead to the erroneous idea that only these two categories "Plantation/Secondary Montane Wet Forest and Plantation/Secondary Submontane Moist Forest" contain Secondary forests. Different from the classification name given, the forest land areas under these two classifications contain a unique and novel combination of elements beyond those implied in their given name. (4)

3.1.3 Comment: There is a significant amount of area under this classification [Plantation/Secondary Montane Wet Forest and Plantation/Secondary Submontane Moist Forest], and the sustainable and adaptive management strategies applied to these lands must be in accordance with their unique values, functions and novel conditions. (4)

3.1.4 Comment: Many of these forest lands are the edge and buffer at lower elevations, where visitors and community stakeholders experience the forest. Therefore, the scientific, cultural and interpretative resources presented about these forest lands must be in accordance with available information on their novel conditions. (4)

Forest Response: Our current categorization of the vegetation communities for El Yunque is based on the geospatial data created by the PRGAP 2000 analysis land cover map (Gould et al. 2007) of the US Forest Service's International Institute of Tropical Forestry (The Institute) GIS and Remote Sensing Lab with expertise from scientists and foresters from the Institute and El Yunque National Forest. The land cover map was modified using information from the Holdridge ecological life zones (Ewel and Whitmore 1973), 600 m elevation line (USGS), and 3300 mm precipitation line (Daly et al. 2003) to create the new vegetation classification.

The areas classified as "Plantation/Secondary Montane Wet Forest and Plantation/Secondary Submontane Moist Forest" are not actively managed plantations nor are they the only secondary forest types on El Yunque. The composition and structure of these two forest types are unique because of the anthropogenic history of clearing, species introduction for reforestation and line planting (mahogany) and natural disturbance events such as hurricanes. There are no errors in having 2 categories of vegetation for secondary montane forest. Our final forest type classification has three types of secondary forests which encompass the unique vegetation of former plantations and mix of native and non-native species.

These lowlands areas are currently being evaluated to decide their best adaptive management strategies. In the plan assessment, there is a need for more data on the composition/structure for future general management knowledge, especially within the lower parts of the Forest. The Forest Plan contains a plan-level strategic vegetation monitoring strategy.

3.2 Comments regarding reforestation and restoration

3.2.1 Comment: It took about 70 years of reforestation and succession to achieve decent forest recovery at the base of El Yunque National Forest. (5)

3.2.2 Comment: On the Island and within El Yunque National Forest, more tabonuco forest has been destroyed than any other type. The amount of so-called "novel" (secondary) forest inside El Yunque National Forest boundaries substantiates that claim. Lowland tabonuco forest is a relatively rare. Should it be restored at lowest elevations where tree size and plant diversity were the greatest in the past? (5)

Forest Response: Section 3.1.2 of the Forest Plan strives for "restoration through natural succession and manage revegetation practices and to maintain the characteristics of the mature tabonuco montain wet and rain forest types."

Restoration activities will be subject to plan guidelines, which include enrichment planting of native species and the conservation of forest canopy preventing openings larger than 0.1 acre of the prevailing coverage.

The Forest Plan contains a monitoring program that will be assessing the general Forest's composition and structure. The data collected will serve to develop conservation and restoration strategies.

3.3 Comment: You have classified some lands as "Secondary," ecologically this means that this type of forest is developing into the original climatic forest but many new evolving forests include non-original species that have naturalized and are part of this new "secondary" forest thus they will become with time a mature forest that includes nonoriginal species creating a new type of forest. This new forest condition is term "Novel forest" in the most recent forest literature, why you do not term those forest as such??? Or is it that you plan to eliminate all individuals of all those species in such lands therefore attaining the original climatic condition?? (8)

Forest Response: The new 2012 Planning Rule emphasizes the use of best available scientific information. The Forest Service considers this as scientific concepts that have been through peer-reviewed process and accepted in university-level textbooks. Thus the concept of Novel Forest is still in a phase of debate within the academic community. The use of one source from a recent publication or publications doesn't provide widely accepted scientific information, at this time. The Forest Service use of a structured classification for forest types is the required means through the new 2012 Planning Rule in addressing vegetation types. Thus "Secondary" is accepted in the forest scientific community and in the agency for those areas with that designation. It meets the definition of composition of vegetation and not the function of such forest types.

4. Invasive species

4.1 There is a need for the best scientific information regarding the management of pests

4.1.1 Comment: Information should be included on pests already identified with their status and how they might be managed. (1)

4.1.2 Comment: Research information on their [pests] distribution, and areas where their control may be of utmost importance for both the native wildlife and for visiting humans should be included. (1)

4.2 Comment: When you realize that for years there has been the documentation of INCREASED NUMBER of MONGOOSE which are also invading the Forest and are

"TESTING POSITIVE" for the RABIES VIRUS," the concern should profoundly increase since as stated in this Forest Plan- the population density surrounding the Forest has increased. (7)

Forest Response: In section 3.1.10 At-Risk Species: Fauna of the Forest Plan, there is a desired condition that establishes that invasive species shall be controlled. Under Table 4-1 of the Monitoring Chapter of the Forest Plan, the mongoose is listed for monitoring under management concerns.

4.3 Comments regarding establishing an animal shelter as part of invasive species control.

4.3.1 Comment: Again in pg 57 (S1 At-Risk Species: FAUNA) is has stated that "Invasive species shall be controlled." Apparently the methods being utilized at present are not truly successful. I believe "this issue needs to be re-addressed" now more than ever. […] Forest Service/Dept. of Agriculture/Wildlife Service/Animal Protection Groups and the P.R. Government need to cooperate and also make a joint effort with the surrounding Municipalities (due to this health issue) to proceed with the plan of PROMOTING the possibility of "making an ANIMAL SHELTER in El Yunque National Forest periphery to address this issue and to serve as an alternative to the communities where they could bring the unwanted animals to a close-by shelter and not abandon them at the Forest. (7)

4.3.2 Comment: Note that on pg 16 (1.7 Issues) states increasing populations and developments near the forest etc. may influence Management Activities. Since now the Forest smiles upon the incorporation of the communities in the lower elevations of the Forest- which should reduce the pressure to the sensitive areas of the forest, the creation of a near-by Animal Shelter would go a long way also towards helping with this stray animal problem. (7)

Forest Response: The Forest Plan scope of management is legally applicable only to the planning area, which is the official El Yunque National Forest lands. Our public interests of structures outside of the Forest is better addressed through Puerto Rico Department of Natural and Environmental Resources because the Forest Service is not mandated to house feral animals.

5. Wildlife

5.1 Comment: I am sure there are more than 166 species of animals in El Yunque National Forest, as established in the plan (page 21) [section 2.3.2.1 of the EIS]. (6)

Forest Response: "There are an estimated 166 animal species found in El Yunque" was removed from the section 2.3.2.1 (Wildlife) of the DEIS and replaced with: "For an administrative baseline, we began with approximately 180 animal species found in El Yunque; that number did change over time with additional scientific sources ."

5.2 Comment: The arthropods probably need a lot more study. (6)

Forest Response: Studying the arthropods is a specific potential research topic and doesn't fit this strategic management document. Also, this species group does not contain any Federally-listed species, but one aquatic invertebrate is a focal species (*Atya lanipes*). The use of partners in future monitoring of these types of animals are noted in the Plan Monitoring section.

5.3 Comment: A description of appropriate species for reintroduction is herein proposed toward rehabilitation of biodiversity of the island's most critically important forest. [See original letter below for listed proposed species] (3)

Forest Response: The Forest Plan scope of management is legally applicable only to the planning area, which is the official El Yunque National Forest lands. Wildlife species belong to the management of the State and not to the Federal government. Thus, the appropriate agency for reintroduction proposals resides with the Puerto Rico Department of Natural and Environmental Resources.

6. Aquatic Ecosystems

6.1 Comment: Several times in the report there is a statement that reads like "development will improve aquatic habitat and more native species." Could somebody please explain how human use of riparian sites will achieve that objective? (5)

Forest Response: Under section 3.3.5.8 Watershed Health: Watershed Condition Framework Quality of the DEIS, there were statements in Table 3-9 where for both alternatives 2 and 3, in referring to CIRMA, it stated that improvements in aquatic habitat were expected and that a higher density of native speces is expected.

The Wildlife and Fisheries team worked with designated water/watershed personnel to rewrite this whole section. Removed: "1) Improvement in aquatic habitat is expected. 2) Higher density of native species is expected." Provided variable results based on the CIRMA expectations of types of activities at each watershed.

6.2 Comment: Also, to establish conservation initiatives from Federal property to State and private areas- to improve the MANAGEMENT and MONITORING of Aquatic Ecosystems. (7)

Forest Response: Through the Forest Service State and Private Forestry programs, the action items of this comment are developed and executed. The management branch of the Forest Service (National Forest Systems) conducts day to day stewardship of public lands.

7. Water Resources

7.1 Comment: There is no mention of the need of sustaining hydrologic connectivity for many of the aquatic species in the rivers of El Yunque. This is critical to maintain El Yunque's aquatic resources in light of droughts and land cover change occurring outside of forest boundaries. The freshwater shrimp species need to migrate to saline and brackish waters to complete their life cycles. These shrimp species are amphidromous, they live in freshwater during their adult life but during early life stages they live estuarine or coastal/marine waters. There are many sources for this information, including Pringle, C. M. 2000. Threats to U.S. public lands from cumulative hydrologic alterations outside of their boundaries. Ecological Applications, 10(4):971-989. (4)

Forest Response: The following Desired Conditions were added in the 3.1.8 Water Resources section of the Forest Plan:

- Sustain the hydrologic connectivity of the rivers flowing from the forest to maintain a healthy aquatic fauna.
- Conserve the aquatic fauna through a healthy and continues hydrologic network flowing from the Forest during the planning period.

8. At-risk species: Fauna

8.1 Puerto Rican Parrot and its habitat

8.1.1 Comment: Somebody has declared that El Yunque National Forest is not preferred habitat for the Puerto Rican Parrot. Therefore, that makes it okay to cut trees, develop recreation sites, and make new trails to communities along the border, and so on. If that is done, will the parrot ever return to lower elevation tabonuco forest? (5)

8.1.2 Comment: Should El Yunque National Forest not encourage recovery of the tabonuco forest with its native species as future parrot habitat? How could this be best done? (5)

8.1.3 Comment: Noel Snyder suggested prohibiting planes from flying at low elevation over the forest. That idea may benefit the parrots… Is it safe to fly at elevations lower than the mountain tops? (5)

Forest Response: Tom White (USFWS) was referred to as the source for the parrot's habitat preference on section 2.4 on the FEIS. In the Alternatives Considered but Eliminated from Detailed Study, the Forest still considers the Puerto Rican Parrot recovery an important management objective.

In regards to cutting down Tabonuco forest type, it is dictated in Desired Conditions 6 and 10 of section 3.1.2 Terrestrial Ecosystem: Vegetation Desired Conditions of the Forest Plan that these types of forests will be conserved.

Through the NEPA process any proposed action in the Tabonuco forest type, or any other forest type, shall go through biological analyses that if any significant impacts are found, mitigations or alternatives shall be included or recommended. The comment of using the new information of the Puerto Rican Parrot's non-preference of El Yunque National Forest will not significantly change current management importance or NEPA analyses.

El Yunque works collaboratively with the Federal Aviation Authority to provide guidance on both manned and unmanned aircraft systems. Presently, flights over the forest are addressed through a FAA recommendation to pilots of not flying below 2,000 feet while transecting El Yunque National Forest. The recommendation is one that FAA can only enforce if individuals can take identification information on non-compliance aircrafts. The Puerto Rican Parrot recovery project members report to the FAA the information collected at a specific time.

El Yunque is not mandated to enforce the airspace over National Forest System lands, as stated in US Forest Service's official Fire & Aviation reference at .http://fsweb.wo.fs.fed.us/fire/fam/aviation/uas/. "The Federal Aviation Administration (FAA) has regulatory authority over all airspace." "The FAA and the U.S. Forest Service consider all Unmanned Aircraft Systems (UAS), regardless of size or weight, to be aircraft. All UAS flown on National Forest System lands must comply with FAA and U.S. Forest Service laws, regulations, and policies. U.S. Forest Service policy stipulates that UAS must be considered the same as manned aircraft in terms of acquisition, approval and carding of pilots and aircraft, inspections, maintenance, avionics, training, and operations."

There are some minor exceptions with Wilderness Areas regulations interpretations of UAS flights over Wilderness Areas.

Social and Economic Sustainability

Comments under this category discuss the continuity of the conservation and acquisition of new lands outside of El Yunque National Forest, conservation education recommendations and other concerns and suggestions.

9. Broader Landscape and Lands

9.1 Comment: Page 4 [Alternatives Considered but Eliminated from Detailed Study] of the Environmental Impact Statement: The reasoning for not pursuing wild and scenic status for additional rivers in El Yunque is weak, it states that there is little public interest in this. I believe that the public is not conscious of this option. (6)

Forest Response: During public meetings, the public expressed strong opinions opposing additional designations for El Yunque National Forest. The 1997 Land and Resource Management Plan resulted in formal designation of over ten thousand acres as wilderness, 1,500 acres as Wild and Scenic Rivers and the protection for an additional five thousand acres as roadless areas. The public sees additional land designations as a limiting factor to land use. In section 2.4 of the FEIS, alternatives considered but eliminated from detailed study reflects the process of addressing this issue.

9.2 Comment: Objectives- should also list something about acquiring lands to protect the Río Mameyes, and rivers other than the Río Espíritu Santo. (6)

Forest Response: The Forest Plan focuses on land acquisition along stream corridors. The 1997 Forest Plan focuses on land acquisitions along the boundary. The Forest Plan is aligned with the comment.

9.3 Comment: FS should develop proposals to establish mitigation banks in the region (14).

Forest Response: The Forest Service does not have the authority outside of National Forest Systems Lands, thus if any interest for "mitigation banks" the Forest shall work with external partners and follow official Lands policy for the agency.

9.4 Comment: The proper and complete protection of El Yunque National Forest should be thought of as extending beyond their 29,000 acres. (7)

Forest Response: The Forest Plan scope of management is legally applicable only to the planning area, which is the official El Yunque National Forest lands. However, we do indirectly address out of forest issues through the following:

Geographic Area El Norte Management Strategy (Section 2.1.3)**:** Work with partners and/or other agencies to apply land conservation programs in forested areas of El Norte Region that include conservation agreements, state and private forest lands as "auxiliary forests," and land acquisition or conservation easement strategies.

9.5 Comment: These rivers [Pitahaya, Juan Martin, Sabana and Quebrada Fajardo] and "Riparian Zones" connect hydrologically the CEN Reserve and El Yunque Forest. Nearby projects should be minimal and eco-touristic to maintain its sustainability and ecologically appropriate management. (7)

Forest Response: The Forest Plan scope of management is legally applicable to the planning area, which is the official El Yunque National Forest lands. Some plan components that address this issue are the following:

Management Strategy for El Norte (Section 2.1.3): Establish collaborative watershed management strategies with the communities and municipalities of the geographic area.

Social Economic Sustainability Management Strategy (Section 3.2.1): Promote increased participation of local landowners, land management agencies, and other key stakeholders in conservation efforts at the landscape scale through an all-lands approach to conservation that identifies key areas for connectivity, multiple uses, and ecosystem services and related opportunities for conservation.

Management Strategy for Riparian Management Zones (Section 3.1.5): Work with partners to recover riparian zones outside the Plan area.

9.6 Comment: We are the owners of two properties that are found in El Barrio Sabana of Luquillo of El Yunque. […] We want to know if our property will in any way be affected by the proposed Environmental Impact Statement. (2)

Forest Response: The Forest Plan scope of management is legally applicable only to the planning area, which is the official El Yunque National Forest lands. Therefore, your properties will not be affected by the Forest Plan and its accompanying Environmental Impact Statement. If you intend to do a project that implies significant changes to your land, you may want to notify the appropriate State agencies.

10. Social and Economic

10.1 Comment: We recommend development of NGOs. (14)

Forest Response: The Forest Plan is based on strong collaboration with current local non-governmental organizations (NGO) such as Centro para la Conservacion del Paisaje, Para la Naturaleza, and Vitrina Solidaria for the development and support of community-based needs in the Forest Plan. The Management Area known as community interface resources management area (CIRMA) was a direct result of this collaboration.

10.2 Comment: [Please] note that it is imperative that our "Forest Service Volunteer Program" be given more attention and expanded, so as to be a vital key also, to the success of any new educational efforts. (7)

Forest Response: The Forest Plan states that integrating Geographic Areas will allow for the expansion of traditional Forest Service programs by integrating schools and municipal governments in planning and projects and adapting educational and interpretation materials to the local context. Additionally, identifying geographic areas permits the identification of and support for targeted volunteer and partnership opportunities related to environmental literacy and education.

In section 3.2.3 Environmental Education, one of the goals is for El Yunque to foster "professional development and skills-based training to staff, volunteers, outfitters, and collaborators who are responsible for providing interpretive and environmental education programs within the Forest." Finally, an objective in the same section is to "develop an interpretation and environmental education training plan within 3 years of Forest Plan approval that fosters professional development and enhances employee and volunteer learning opportunities in the areas of interpretation and environmental education".

Multiple Uses

Comments under this section cover concerns over timber harvesting viability, recreation, watershed use and general use of different management and geographic areas.

11. Ecosystem Services

11.1 Comment: The most important values and uses of El Yunque National Forest are for wildlife (plant and animal) protection, water supplies, passive recreation, and environmental education. All of these functions have greater value than disturbing the environment for other purposes. (5)

Forest Response: Through the new 2012 planning regulations, all values and uses from the public are noted and processed through public meetings. The Forest Service shall encourage all appropriate land uses as dictated in legislative acts such as the Multiple-Use Sustained-Yield Act of 1960. From the Forest Plan Assessment these values and uses stated above are consistent with the finding of the document. Management Strategies and Guidelines in the Forest Plan reflect many of these values and uses for partnerships to result in maintaining and improving the level of yield from the ecosystem services of the Forest.

12. Recreation

12.1 Comment: There needs to be an intent for more inclusivity for recreation opportunities for people with disabilities. (6)

Forest Response: In the new 2012 planning rule, inclusiveness was a priority for the public collaboration period and many different needs were presented to the planning team. This resulted in plan components such as: Guidelines in section 3.3.8 in the Forest Plan states, "consider the needs for people with disabilities in the design of facilities".

12.2 Comment: Regarding page 30 [MA4, section 2.1.4 of the Plan]: It would be good to emphasize more the potential for recreational development in MA4 zones. Only dispersed camping is mentioned. I think there are areas in this zone that would potential for development as small group camping sites. I am not sure you actually want people camping anywhere in the forest on non-established or non-designated sites. High rainfall can result in high impacts, even in more level areas. The Asociación de Acampadores of Puerto Rico would be able to help evaluate areas for camping and hiking in MA4. (6)

Forest Response: In this strategic document, Forest Plan, the Forest Service doesn't limit recreational proposals, in so much these proposals comply with NEPA. In the Forest the Desired Condition section 2.1.4 which is the description of management areas, the following is stated: "Provide spaces and opportunity to offer new disperse camping prospects".

12.3 Conflicts with Management Area 3 for recreation and communications

12.3.1 Comment: Why is the primary objective of Management Area 3 communications facilities and not recreational and scenic value protection? When was this objective determined? Have the original needs of this objective been re-evaluated? (4)

12.3.2 Comment: There is overlap between the Communications and Recreation Management Areas that occur along road 10 and trails that lead to various landmark scenic and recreation sites and communication facilities. This seems to be in conflict with the desired conditions statements to "provide special protection to species-at-risk, and for the most limited and unique forest types such as the Montane Rain Cloud Forest." (4)

12.3.3 Comment: There is overlap between the Communications and Recreation Management Areas and unique forest types such as the Montane Rain Forest and the Montane Rain Cloud Forest. Access to recreational settings along road 10 provide unique scenic and natural experiences, this should not only be maintained, but also improved. How will this be achieved? (4)

12.3.4 Pages 27, 28 [MA3 of section 2.1.4, Forest Plan]; Management Area 3, Desired conditions should be more explicit. (4)

Forest Response: Management Area (MA) 3's title is Communications and Recreation, however the description of the MA provides the viability of the communication apparatus and their access. Within the current MA occurs recreation trails and scenic opportunities, but these

recreational elements do not supersede the present communication structures found there. These communication structures have already been existing for multiple decades and are an accepted land use action. The recreational elements are intended to not be in conflict through providing to the extent such that their use do not directly clash with the primary communication facilities.

12.4 Regarding the communications facilities within Management Area 3

12.4.1 Comment: How will the facilities energy efficient standards be attained, evaluated and measured? (4)

12.4.2 Comment: Will energy efficiency apply to their communications services or to their building structure, or to both? How will the known and documented effects of light pollution be minimized or eliminated at these facilities? Will technology and infrastructure improvements be required continually from communication sites such as to minimize visual presence and impartment of recreational values? Will communication establishments/facilities located on Road 10 be required to have continuous maintenance for safety and visual compliance to scenic recreational goals? (4)

12.4.3 Comment: How will the following statement be evaluated? "The Forest accommodates communication uses that cannot be met off-Forest; however, communication sites will occupy the same or reduced areas on the peaks." If communication sites will indeed become energy efficient, then reduced area occupation should be expected and achieved. (4)

Forest Response: Energy efficiency shall be addressed through the special use process for the structures of the communication apparatus found in the two locations on the Forest.

Light pollution is not addressed in this DEIS.

Technology and infrastructure improvements will be addressed on a case by case basis regarding the Special Use permit renewal process.

Regarding maintenance: No scenic goals established in the plan. The management should comply with the standards on the operation plan for the communications site area if there is one.

Regarding reduced areas on the peaks: Consolidation of communications sites in fewer structures will be required when feasible (Goal 2).

12.5 Recreation Trails

12.5.1 Comment: More recreation trails are suggested for the forest borders. El Yunque National Forest cannot maintain the current system. Will more trails encourage more motorcycles, mountain-biking, and disturbance along the lower forest boundary? The Angelito Trail is an example of a new trail in bad condition. Shortcuts have destroyed parts of the trail. (5)

12.5.2 Comment: El Yunque National Forest reopened a trail from the southern recreation site on route #191 so that people could enter the forest from that point. As Weaver recalls, that trail "re-reconstruction" deviated in areas from the old trail, and led hikers into the Wilderness Area. El Yunque National Forest cannot maintain its current trail system. Are more trails advisable? (5)

Forest Response: In section 2.1.4 for MA 2 (El Yunque Recreation Zone) there is an objective: "facilities for recreation activities such as hiking, camping, and trails system are

maintained and restored appropriately during the plan period." This means that although not all trails are currently maintained, the Forest shall make it into a priority whenever funding or the opportunity arises. In the CIRMA, the management area that occurs on the periphery of the Forest, recreation-related projects are within an acceptable range of activities. The significant difference is that any recreation-related structures are collaboratively managed. That means a reduction in costs to the government and a higher sense of being stakeholders by the public. There is a management strategy that emphasizes to include discussions from multiple sources during the NEPA process in trail planning.

12.6 Safety Issues

12.6.1 Comment: The forest should consider the implementation of safety systems at recreation sites like alarms, sirens and warning notifications for incident prevention. (14)

12.6.2 Comment: There is a safety and trash issue associated with proposed recreation area. (14)

Forest Response: The desired conditions for recreation management recognize the role of visitor safety. The establishment of safety systems are site-specific decisions to be analyzed during plan implementation.

12.7 Comment: Should crowding be controlled for the sanity of people who go there because they love the forest? (5)

Forest Response: Under the Multiple Use Sustainable Yield Act of 1960, different uses such as recreational are accepted for National Forest use and the Wilderness Act provides for a recreation experience where humans have not trammeled the area. Therefore, you have the areas that are designated for general recreation use, where unfortunately there are periods of extreme use, but the Forest Plan anticipates the dispersal of visitor use in future projects. Recreation users also have the uncrowded areas of El Toro Wilderness Area for solitary enjoyment.

12.8 Comment: [Regarding the] need for New Trails System that will connect El Yunque Forest with other adjacent lands in lower forest areas to help create new RECREATION opportunities at the more lower elevations of our Forest System. The interest in this project continues but […] the collaboration with local towns, residents and organized regional groups needs to be strengthened. This focus would help satisfy the new increased necessities of the Dept. of Recreation and Tourism-for the over one million yearly visitors to the Forest by helping alleviate the "over density situation" being created, especially during the Forest high season. (7)

Forest Response: The Forest Plan does propose a new regional trail system for the Geographic Area of El Norte. Also, for El Norte, the plan has a Management Strategy that states that the Forest will develop collaborative, conservation and interpretation initiatives with the municipalities, residents, and organized regional groups through the plan duration, which will be applied in the further development of this trail system. Another management strategy for this area is to work with the communities in developing recreational alternatives outside the forest, which will also be a part of that.

13. Forest Products

13.1 Comments regarding timber harvesting and profits to be made

13.1.1 Comment: Timber harvest should only be carried out if the government makes money, and simultaneously, other more meritorious objectives are implemented (for example, restoration of lowland tabonuco forest, an endangered forest type). Many of the favorite timber species for artisans are relatively rare. (5)

13.1.2 Comment: Logging means fragmentation, road damage, soil disturbance, impacted water supplies, economic studies, accounting, field supervision, possible damage to future parrot habitat, and so on. Do economic studies describe probable environmental impacts? How about a guaranteed profit for the government? (5)

13.1.3 Comment: Cut for what purpose? Demonstration is not a justifiable reason. Making money is. Is there any money to be made? Is cutting El Yunque National Forest worth the effort? (5)

13.1.4 Comment: Support timber cutting on managed properties outside of El Yunque National Forest. El Yunque National Forest is practically sacred to many folks on the Island. Let's keep it that way. Forests outside of El Yunque National Forest could be cut by private owners. Can El Yunque National Forest help them? (5)

13.1.5 Comment: I do not agree in which any number of trees are cut in the forest of El Yunque. (13)

Forest Response: The Plan is not project specific, and is not suggesting that it would be undertaking any sort of program for solely timber management. In Chapter 2, under section 2.3 Suitability for Timber Harvesting the following is stated: "It needs to be clarified here that lands classified as "suited for timber production" does not mean that they will be managed as "timber plantations." The estimates presented in Table 2-7 are the acres that are potentially suitable for harvesting; however, it does not mean that harvesting activities will occur on all those acres.

The Community Interface Resources Management Area (Management Area 4) includes a Forest Product Strategy but it provides the guidelines and management strategy defining that the expected products will come from the utilization of wood products from post and pole sizes (less than 8 inches DBH). The management strategy is considered a silvicultural application of a low thinning promoting and enhancing the native species composition of the management area; not a profit results strategy for forest products. The efficient utilization of the viable forest products produced under this management regime will be considered to promote local businesses including local wood products that could be sold by local artisans according to the management area's desired conditions and goals. In Table 2-7, the only land identified as being suitable for timber production are the ones in management area 4.

The Plan defines the allowed tree cuttings in Management Area 4 Community Interface Resources Management Area (CIRMA) in guideline 5 (section 2.1.4 of the Forest Plan). Appendix B of the Forest Plan also identifies that it is anticipated that only around 22 acres within the CIRMA will be treated each year.

In the Vision and Management Themes (section 1.7 of the Forest Plan), the development of sustainable and collaborative projects with the public and private sector is considered. One of the five core management themes is directed toward promoting a stronger regional identity.

14. Watersheds

14.1 Comment: Correct: "Cloud elevation shifts" instead of cloud "evaluation" shifts on page 90 [section 3.3.4.2 of the EIS]. (4)

Forest Response: Yes, the word "evaluation" is corrected to state "elevation"

14.2 Comment: The section 3.3.5.1 [FEIS] Affected Environment: Watersheds, Conditions and Trends of the Current Land Management Plan Moving Toward the Desired Future Conditions could benefit from integrating the pertinent information available in Heartsill-Scalley and López Marrero 2014. (4)

Forest Response: The reference was added with the following: "Additionally, Heartsill Scalley and López-Marrero (2014) present a landscape assessment quantifying land-cover composition at watershed and riparian-zone scales in El Yunque Region, correlating this information to water-quality parameters and showing a relationship between land-cover composition and water condition, especially regarding urban/built-up cover and forest land cover that could help prioritize watersheds and river sections for restoration or management projects for water condition improvement."

15. Special Uses

15.1 Comment: Baño de Oro is not identified as a National Natural Landmark in the DEIS. Recommend including the Designation. (11)

Forest Response: We corrected to identify Baño de Oro as National Natural Landmark.

15.2 Comment: El Toro Wilderness Area: No mention is made of the Limits of Acceptable Change committee for the wilderness area that met in 2011. A final report was produced, which José Ortega should have. Several of points on Pgs. 32-35 [Section 2.1.4, MA 5] coincide with the recommendations of the LAC committee. (6)

Forest Response: El Yunque National Forest currently has no Wilderness Plan. However, the Forest commits itself in the new Forest Plan to complete a Wilderness Plan within the first two years upon the Forest Plan approval. This Wilderness Plan will have a public review process and will take into consideration enabling legislation and previous assessments.

15.3 Research activities

15.3.1 Comment: I believe the draft plan needs to include a component on addressing research needs at El Yunque National Forest. Forest managers will have an idea of further research needed to inform management. An outline or examples of these research needs should be included in the plan, with the general direction indicated and general prioritization of research needs. This would indicate that managers know that not all information is at hand, but a plan is at hand for progress. (6)

15.3.2 Comment: I believe that the plan should also include the intent to form a scientific advisory committee, to promote the agenda of needed research in the academic community. Intention for an efficient permitting process should also be indicated, to help the needed research move forward in a timely way. (6)

15.3.3 Comment: The plan does not mention certain research projects that are not in the designated research areas. These would include- 1) genetic trial and gene bank for a large mahogany study, 2) the arboretum located near Carr. 186 3) long term study sites such as the 400 series plots, and the Palm, Colorado, and Tabonuco plots. (6)

15.3.4 Comment: It would be good for El Yunque National Forest to have a registry with the locations of all study locations in the forest. The Management Plan could refer to this database, and it should be accessible to the planning team. (6)

Forest Response: El Yunque National Forest has dual designation, where it manages the Forest along with the International Institute of Tropical Forestry (IITF). Thus, when specific research proposals arise, both IITF and El Yunque National Forest collaborate on its appropriateness and integration with other projects. The National Forest System doesn't have authority to conduct Agency research. That function belongs to IITF, which is the research branch of the Forest service in Puerto Rico. Management area 6 is designated in the plan as focused for research on El Yunque. One of its desired conditions establishes the following: "Provide opportunities for long-term intensive scientific investigations including treatment vs controlled research…..etc." The Research Working Unit Description, which entails future directions for studies, was considered during the assessment process. The assessment process considered all research activities that occurred or are occurring in the National Forest as part of the description of the current condition.

15.4 Comment: The draft plan and the DEIS have taken a detailed look at the information available on target species. But I think one of the priority research needs is more biological inventory, including geolocation and habitat characterization information, reproductive information, food dependencies, interspecific relationships. This is particularly true for El Toro Wilderness Area, to know more about the occurrence and sustainability of sensitive species in relation to potential human use. More extensive inventory research would be ideal for undergraduate and graduate research projects and could be promoted by the scientific advisory committee suggested in Point 6, at various institutions in and out of Puerto Rico. (6)

Forest Response: This is a thematic research study statement. These research specific proposals would not be included in a wildlife and fisheries management program planning component. For management we only do presence and absence monitoring to obtain focal species occurrences throughout the forest to observe if certain management strategies are effective. The operation of the national forest does not include the mandate to address or perform research.

The main task of research is delegated to IITF and through collaborative research discussions this theme will be communicated to them.

15.5 Comment: I understand the Com. Facilities at the east end of El Yunque Peak site have presented interference issues (which were being minimized). […] I understand there is a proposal for the removal of this facility"? […] So I understand the "NOISE POLLUTION" here "continues' and the ever present concern re[garding] the amount of "RADIATION EMISSION LEVELS" also. The FCC –Federal Com. Commission- needs to MONITOR this closely, according to regulations. These problems need to be addressed, and explore what up-to-date (green-technology) exists now. This could help "minimize" the size of quantity of structures and the amount/frequency of radiation being emitted. To ultimately REDUCE the "negative impacts to the bio-diversity" of this pristine area! Though tourists may not see this area; our nature and different species can feel its probable adverse effects. (7)

Forest Response: Under the National Forest Management Act and the New 2012 Planning Rule, El Yunque National Forest ensures that all legitimate use of public lands are in compliance. Many components of this comment rely on FCC authorities. Under our current special use permits program, the Forest collaborates on relevant issues that may produce land-use conflict. Any new green energy proposals shall go through the NEPA analysis at the project level. In section 2.1.4 of the Forest Plan, under Management Area 3: Communication and Recreation, a desired condition states the following: "The Forest accommodates

communication uses that cannot be met off-Forest; however, communication sites will occupy the same or reduced areas on the peaks."

15.6 Comment: A considerable segment of our infrastructure is found inside the lands of El Yunque. In the past, visitors of the Río Sabana Area frequently trespassed inside our area if operation. In 2010, the Naguabo Municipality built a recreational area know as: Sabana Picnic Area. This area is adjacent to the access entry area to the hydroelectric project of Río Blanco. This action increased the number of individuals that went into our area of operation, for which additional security measures had to be implemented to avoid possibility of access. […] for this reason, we built a gate for access control, for which the keys have been available for inspection from US Forest Service staff. Additionally, we installed signs that read "entrance is prohibited," however visitors still look for a way to enter the premises. AEE [PREPA] makes record of this security and trash issue that may arise in the proposed recreation areas; especially those that may be in proximity to sensitive zones of the forest system. Also, there is a high possibility that criminal activities may occur in the area along with detriment of ecosystems. The proposed action will need to establish in these recreational areas an aggressive plan the will possibly require the recruitment of personnel to perform a continuous and effective monitoring function in these areas. (14)

Forest Response: Under the Multiple Use Sustainable Yield Act of 1960, recreation is an accepted use on Forest Service Lands. Thus, in the past, significant public interest proposed the Rio Sabana Picnic Area development. It is unfortunate that the recreation area is resulting in visitors trespassing to the areas managed by PREPA (AEE) for the hydroelectric dam on Rio Blanco. The new Forest Plan looks forward to collaborating with partners, including PREPA, to further reduce land-use conflicts.

16. Scenic Character

16.1 Comment: DEIS should include a more detailed description of how the scenic byway will be constructed. (9)

Forest Response: The Forest Plan establishes a scenic byway management area. Construction of a scenic byway is a site-specific decision. Such an action goes through an analysis, design and planning process which contains detailed descriptions. Specific constructions would be found in project-level proposals. The following plan components provide parameters for future action items to this section of designated roads:

In section 2.1.4, Management objective for management area 9 it says, "Improve and maintain the corridor's physical condition within the first 3 years of the Forest Plan's approval." A standard for the same management area says, "All road maintenance and alterations…should follow the stipulations of the State Historic Preservation Act…etc."

17. Cultural and Historic Resources

17.1 Comment: Recommend that under Standard 2 of the cultural and historic resources section to add the following texts: "MOA and binding documents." (12)

Forest Response: The fore mentioned text was used with the acronym MOA spelled out to Memorandum of Agreement.

18. Facilities and Transportation

18.1 Concerns regarding fuel use and quality.

18.1.1 Comment: Use of diesel equipment will be required. Clean diesel options should be considered. (9)

18.1.2 Comment: Consider implementing diesel controls. (9)

Forest Response: Use of diesel is a project based activity, not a plan component. Activities on National Forest lands need to follow EPA regulations.

19. Other

19.1 Comment: In general, the partnership needs to be better developed between El Yunque National Forest and the academic community, in addition to partnerships with local communities and other stakeholder groups. (6)

Forest Response: Although this comment is non substantive; the Forest Plan in section 2.1.4 Management area 6 "Research" states that the Forest will coordinate with IITF, who are mandated for scientific work, and other cooperators to make the best use of the research opportunities provided by the Forest. In Management area 4 "CIRMA," the entire desired conditions, standards & guidelines are developed for improved partnerships with local communities and other stakeholder groups.

19.2 Comment: El Yunque National Forest (El Yunque National Forest) has piles of information on plants, animals, and the environment, probably more than any other national forest. El Yunque National Forest has a unique research-management relationship and is the only tropical forest in the system, but introductory statements gloss over what that means. Should it be pointed out better? (5)

Forest Response: Section 1.6 of the Forest Plan describes the unique and distinctive roles and contributions of El Yunque National Forest. Additionally, in the plan components, there are multiple references to the Forest's inherent exceptionality through desired conditions, objectives, standards, guidelines and management strategies.

19.3 Comment: Developing a plan with duration of 15 to 20 years I do not consider appropriate. Everyone knows that effective development plans are short-lived. Those who work with nature know it is in constant motion. Therefore, their needs are variants. (13)

Forest Response: Under the National Forest Management Act, Forest Plans are supposed to be 10-15 years in length, instead of the 15-20 years as stated in the comment above. The new 2012 planning rule continues the use of amendments to the Forest Plan if there is an identified need to do so. This has been and will be an important tool for managers to use whenever there are changes within nature or human-needs. In the Forest Plan we emphasize adaptive management. Thus our monitoring is designed to give short and long-termed scientific observations of current management strategies outcomes. Monitoring reports conducted every 2 years will be important for Forest Service leadership making decisions on any changes to meet desired conditions.

Comment Letters Submitted

Marimar Bonet Arroyo

[redacted]

[redacted]

12/26/2016

Subject: Proposed Plan for Forest Management

Attention: Mrs. Sharon Wallace

El Yunque National Forest

Distinguished Mrs. Wallace

Anyone who has understanding and respect for himself and towards nature understands that each tree is important for the effective development of the forest and the diversity of life there.

I do not agree in which any number of trees are cut in the forest of El Yunque.

Developing a plan with duration of 15 to 20 years I do not consider appropriate. Everyone knows that effective development plans are short-lived. Those who work with nature know it is in constant motion. Therefore, their needs are variants.

The earth, their lands and the planet do not have owners, it is our home. The home of all species and living things that we should treat with the same respect that we wish to be treated. Only those who understand their nature can understand the nature of everything around them.

Research in the educational and scientific areas can be developed more widely. There is much that can be developed in these areas. At the tourism level, work can be done more widely, programs for conservation and make aware on the importance of forests and their positive effects on the therapeutic areas can be developed. Instead of taking away from the forest that gives us so much, let us honour and learn from it.

Thank you for your understanding and respect for the life of nature and other living things.

Respectfully,

Marimar Bonet Arroyo

Date submitted (SA Western Standard Time): 10/7/2016 2:20:45 PM
First name: Enrique
Last name: Hernandez-Prieto
Organization:
Title:
Official Representative/Member Indicator:
Address1: [redacted]
Address2:
City: J[redacted]
State: P[redacted]
Province/Region:
Zip/Postal Code: [redacted]
Country: United States
Email: [redacted]
Phone: [redacted]
Comments:

I attended the Las Piedras Meeting on the proponed El Yunque Management Plan (October 6, 2016). I found the presentation enlightening and well organized. Much of the information on how our understanding of the forest has changed was new and convincing, and many questions were clarified. I applaud the effort of the personnel present.

As a wildlife biologist, I would like the proposed management plan to include information on pests (both plant and animals) already identified at El Yunque, the status (widespread, localized, etc.) and information on how they might be managed. Aa an example, the mongoose seems to be widespread and presents a risk to human visitors, but cats may not be so.Their effects on landbirds of the forest is important, but there is no information on how will they be managed. This may require research by the forest service on distribuci?ns, and ?reas where their control may be of utmost importance for both the native wildlife as for the visiting humans. A list of identifica pests should be included and if possible, any available information on their distribuci?n through the forest (at least of sightings).

I agree that the second alternative of the three presented is the best one.

In re: To the follow-up Comments-submitted to the Forest Service in May11' 2011 re: The Forest Planning Rule and Oct.30 '2015 Forest Plan Draft.

US FOREST SERVICE

DEC 28 2016

EL YUNQUE NATIONAL FOREST

From: Diana de Ju
Sent: Wednesday, December 28, 2016 8:27:56 PM UTC
To: commentselyunqueplan@fs.fed.us
Cc: Ricardo Ju
Subject: In re: To the follow-up Comments-submitted to the Forest Service in May11' 2011 re: The Forest Planning Rule and Oct.30 '2015 Forest Plan Draft.

Greetings to all. My name is Diana de Ju and I humbly Re-Submit the comments (plz. read) which I wrote on Oct. '2015 re. the then Forest Plan Draft. Please note the suggestions I submit are in answer to the concerns I still have -after having read the recent FINAL FOREST PLAN of Sept'16. The FS Plan is fantastic- and I applaud their huge efforts, but I sincerely hope the suggestions and concerns of today- will be considered in the preparing of this FINAL Forest Plan for "2017"..

.. Concerns or Suggestions ..

1) Re: The Telecommunications Towers facilities in "El Yunque". I understand the Com. facilities at the east end of the El Yunque Peak site have presented interference issues (which were being minimized). Note that from a distance and at the Recreation site near this area- the shocking view of Large Antennas and their large (unsightly)concrete structures are super visible. I understand there is a "proposal for the removal of this facility"?

**But at the East Peak Com. Facility- (since there is no Recreation Site nearby), it's less visible to tourists.

So, I understand the "NOISE POLLUTION" here "continues" and the ever present concern re: the amount of "RADIATION EMISSION LEVELS" also. The FCC-Fed'l Com.Commission- needs to MONITOR this closely, according to regulations

(for follow-up). These problems need to be addressed, and explore what up-to -date (green-technology) exists now.

*This could help "minimize" the size or quantity of structures and the amount/ frequency of radiation being emitted. To ultimately REDUCE the "negative impacts to the bio-diversity" of this pristine area! *Though tourists may not see this area; our nature and different species can feel its' probable adverse effects..

2) Re: EDUCATION.. It is interesting that in "2012" the CCPP- Collaborative Committee for Public Participation was formed. One of its' goals was to improve collaboration and community involvement, during this Forest Plan Revision process. Also to establish a commitment to conserve the priority eco-systems and provide social opportunities/economic benefits to both visitors and local communities. Now in 2016 with the Forest Service, we of the (CCPP) recently began with our 1st. (CCPP) Education Project- at (2) schools (in [redacted] of Forest). We thank the Fish n' Wildlife Dept. for their

grant- which energized this joint effort. Hopefully this Education Project will serve as an incentive- and spread to

reach all of the 9 Municipalities (towns) that surround the El Yunque Rainforest!

* Under Education Guidelines (3.2.3) pg.64 - (G6) mentions the need to "update materials" for the youth especially. We need to "increase environmental literacy" and help educate our local communities- by integrating their schools and the municipalities that border the FOREST region. This calls for adapting EDUCATION and INTERPRETIVE teaching materials

to the "LOCAL CONTEXT". One example is (with all due respect) is the use of the "owl and bear" -widely recognized stateside -for teaching. Experience has shown that local youth of this small Caribbean island, would relate even more

to a "local character" such as the Puerto Rican Parrot and our Coqui etc. (at the Elementary School age). Also (G6)

mentions re: (interpretive and Educational programs)- they are assessed to gather feedback and monitor the

effectiveness of the programs. This will help identify "future needs" direction- that can be added during the Prog. re: for example, identified issues- that need help (to resolve with time and continued focus).

Plz. note that it is imperative that our "Forest Service Volunteer Program" be given more attention and expanded, so as to

be a vital key also, to the success of any new educational efforts..

(3) Re: Need for New Trails System- that will connect the El Yunque Forest with other adjacent lands in lower forest areas. To help create new RECREATION opportunities at the more lower elevations of our Forest System.The El Yunque Trail would reach the coastlands of the North-East Ecological Corredor Reserve (RCEN), and would integrate and facilitate alternative trail access from for example, The Municipalites of Rio Grande and Luquillo- to the RECREATIONAL areas of the Forest. The interest in this project continues but, (plz. see #3 of my report)- the collaboration with local towns, residents

and organized regional groups needs to be strengthened. This need is mentioned in the 'Forest Plan 2016' that-

for years the effort has gained interest with groups such as the Puerto Rican Land Trust, The Coalición Pro-Corredor Ecologico del NE(with its' 14 org's.) and the Puerto Rico Camping Society. This focus would help satisfy the new increased necessities of the Dept. of Recreation and Tourism -for the over one million yearly visitors to the Forest. By helping to alleviate the"over density situation" being created, especially during the Forest high season.

(4) Increased protection of the Rivers that empty into the Atlantic Ocean and its' Coral Reefs:

Plz. see (#4) of my report. The (Pitahaya, Juan Martin, Sabana and Quebrada Fajardo Rivers) are examples

of rivers that are born in and flow from "El Yunque" and later empty into the CEN Reserve. These Rivers and Riparian

Zones "connect Hydrologically- the CEN Reserve and the El Yunque Forest". Nearby projects should be minimal and

Eco-touristic to maintain its sustainability and ecologically appropriate management. These Eco-systems clearly

have no boundaries. The proper and complete protection of the EYNF should be thought of as extending beyond their

29,000 acres. To ensure the "entire protection and continuity" of all its' delicately balanced eco-systems.

**Plz. note that the possible contamination caused by deterioration of the quality of the waters (due to human

activity as the principal factor/ sedimentation etc.) -results in the environmental degradation of the coral reefs etc.

The Environmental Education at all levels should coincide with these facts, and the need for "Education

from the Forest to the Communities". Also to establish conservation initiatives from Federal property to State

[redacted] 12/28/2016

and private areas - to improve the MANAGEMENT and MONITORING of Aquatic Ecosystems. The use of a RENEWED

EFFORTS by all parties concerned - to include the "public participation" in all our efforts and the engagement of

community based groups, enterprises etc. for River and Riparian area restoration and conservation efforts!

(5) (Plz. read pg.4 of my report #5) Re: Stray and abandoned animal (dogs and cats) in the El Yunque Forest.

This report explains many facts which need to be scrutinized due to the impending HEALTH ISSUE that with each

year threatens to explode, and maybe affect the health of visitors- to our beloved Forest.

*Note that at the "2005" Forest National Centennial Congress in Washington, the then Caribbean National Forest

made an "Official issue" of the Exotic Species or Non-native Stray Animals. "Stray Dogs and Cats" were among the

(5) listed species, that are invading the Forest. At the Congress they stated that "Domestic animals exotic to the

Forest (such as dogs and cats) need to be kept away from the Forest and the government should provide for

SHELTERS to address this issue". When you realize that for years there has been the documentation of INCREASED

NUMBERS of MONGOOSE which are also invading the Forest and are "TESTING POSITIVE for the RABIES VIRUS".

The concern should profoundly increase since as stated in this Forest Plan-The population density surrounding the

Forest has increased. There are now more homes near-by with mascots that are sadly abandoned near or in the

Forest vicinity and become strays. The intermingling of SICK MONGOOSE with the stray population 'is inevitable'.

and obviously a RABIES THREAT is eminent..

*pg 143 (3.4.4.4) re: NON-NATIVE FAUNA states- Terrestrial Species such as Mongoose , feral dogs and cats (as

reported in the '2014' Forest Plan Assesment states " some of these species are associated with Recreational Areas

(due to the "availability of food leftovers"). Apparently the effects to possible Health is expected to be controlled

by "the trapping and removal of feral dogs, cats and mongoose" which is considered as part of the standard and

guidelines management applications. *Again on pg.57 (51) re: At-Risk Species: FAUNA It has stated that "Invasive

species shall be controlled"! Apparently the methods being utilized at present are not truly successful. I believe

"this issue has to be re-addressed" now more than ever.

We must work together to find a solution. Forest Serv./Dept. of Agriculture/Wildlife Serv./Animal Protection groups

and the P.R. Government- need to cooperate and also make a joint effort with the surrounding Municipalities

[redacted] 12/28/2016

(due to this Health issue) to proceed with the plan of PROMOTING THE possibility of "making an ANIMAL SHELTER

in the EYNF periphery"! To address this issue and to serve as an alternative to the communities. Where they could

bring the unwanted animals to a close-by SHELTER and not abandon them at the Forest. Besides the teaching of

Humane Education here and at the adjacent schools. This Shelter would serve with "low cost sterilization and

Vaccination Programs" and even Adoption Progs. etc., to stimulate responsibility in the families. Also to teach

and make the local families aware of the delicate Rainforest that surrounds them and ways to help their forest.

Note that on pg.16 (1.7) ISSUES- states increasing populations and developments near the Forest etc. may influence

Management Activities. Since now the Forest smiles upon the incorporation of the communities in the lower

elevations of the Forest -which should reduce the pressure to the sensitive areas of the forest. The creation of a

near-by Animal Shelter would go a long way also, towards helping with this stray animal problem..

I thank you all for your interest in reading my concerns and truly hope we join efforts to continue to help as much

as possible the completion of this Forest Plan and that it be done as justly possible for the protection of our so

unique and beautiful National Forest and for the well being of our citizens and many tourists that each year visit..

Cordially submitted by : Diana de Ju (CPCEN/ CCPP)

Please feel free to contact me if you wish any clarifications on what I have expressed.

[redacted] e-mail use: [redacted]

[redacted] 12/28/2016

By Tamara Heartsill-Scaley:

Comments on El Yunque National Forest Land and Resource Management Plan Draft, and Draft Environmental Impact Statement.

Land and Resource Management Plan Draft
Page 27, 28; Management Area 3, Desired conditions should be more explicit.
How will the facilities energy efficient standards be attained, evaluated and measured? Will energy efficiency apply to their communications services or to their building structure, or to both? How will the known and documented effects of light pollution be minimized or eliminated at these facilities? Will technology and infrastructure improvements be required continually from communication sites such as to minimize visual presence and impartment of recreational values? Will communication establishments/facilities located on Road 10 be required to have continuous maintenance for safety and visual compliance to scenic recreational goals?

How will the following statement be evaluated? "The Forest accommodates communication uses that cannot be met off-Forest; however, communication sites will occupy the same or reduced areas on the peaks." If communication sites will indeed become energy efficient, then reduced area occupation should be expected and achieved.

Why is the primary objective of Management Area 3 communications facilities and not recreational and scenic value protection? When was this objective determined? Have the original needs of this objective been re-evaluated? There is overlap between the Communications and Recreation Management Areas that occur along road 10 and trails that lead to various landmark scenic and recreation sites and communication facilities. This seems to be in conflict with the desired conditions statements to "provide special protection to species-at-risk, and for the most limited and unique forest types such as the Montane Rain Cloud Forest".
How is rainwater management integrated into these goals and desired conditions? There seem to be limited pluvial water management structures (to reduce erosion) associated to the communication facilities, including roads, in this management area 3 and in the discussion of Management Area 9, for the Scenic Byway Management Area of PR Route 186.

p.46, 47; 3.1.2 *Terrestrial Ecosystem: Vegetation*
There is overlap between the Communications and Recreation Management Areas and unique forest types such as the Montane Rain Forest and the Montane Rain Cloud Forest. Access to recreational settings along road 10 provide unique scenic and natural experiences, this should not only be maintained, but also improved. How will this be achieved?

Under the section of Goals the statement -
"*Evaluate ecological vegetation composition and ecological functions of the Plantation/Secondary Montane Wet Forest and Plantation/Secondary Submontane Moist Forest, to apply the appropriate management strategy.*"

Knowledge on ecological vegetation composition and ecological functions should be used to categorize the existing forest communities and ecosystems. The areas identified as "*Plantation/Secondary Montane Wet Forest and Plantation/Secondary Submontane Moist Forest*" are not actively managed Plantations, nor are they the only secondary forests in El Yunque. Many of the

other forest types described/named contain and are Mature Secondary forests. Therefore the currently used naming convention may lead to the erroneous idea that only these two categories "*Plantation/Secondary Montane Wet Forest and Plantation/Secondary Submontane Moist Forest*" contain Secondary forests. Different from the classification name given, the forest land areas under these two classifications contain a unique and novel combination of elements beyond those implied in their given name.

Knowledge about these forests types points towards their conservation value. There is a significant amount of area under this classification, and the sustainable and adaptive management strategies applied to these lands must be in accordance with their unique values, functions and novel conditions. In addition, many of these forest lands are the edge and buffer at lower elevations, where visitors and community stakeholders experience the forest (Map page 57). Therefore, the scientific, cultural and interpretative resources presented about these forest lands must be in accordance with available information on their novel conditions.

NOTE: Page 90. Cloud elevation shifts instead of cloud "evaluation" shifts.

Comments on *Draft Environmental Impact Statement*

The section 3.3.5.1 Affected Environment: Watersheds, Conditions and Trends of the Current Land Management Plan Moving Toward the Desired Future Conditions could benefit from integrating the pertinent information available in Heartsill-Scalley and López Marrero 2014 *(PDF link provided below).*

Section 3.4.2.1 Affected Environment, *Page 102.*

These is no mention of the need of sustaining hydrologic connectivity for many of the aquatic species in the rivers of El Yunque. This is critical to maintain El Yunque's aquatic resources in light of droughts and land cover change occurring outside of forest boundaries. The freshwater shrimp species need to migrate to saline and brackish waters to complete their life cycles. These shrimp species are amphidromous, they live in freshwater during their adult life but during early life stages they live estuarine or coastal/marine waters. There are many sources for this information, including Pringle, C. M. 2000. Threats to U.S. public lands from cumulative hydrologic alterations outside of their boundaries. Ecological Applications, 10(4):971-989

Resources suggested for watersheds, riparian and stream sections:

Land-cover composition, water resources and land management in the watersheds of the Luquillo Mountains, northeastern Puerto Rico https://www.treesearch.fs.fed.us/pubs/49358
https://data.fs.usda.gov/research/pubs/iitf/ja_iitf_2014_Heartsill001.pdf

Effects of drought and hurricane disturbances on headwater distributions of palaemonid river shrimp in the Luquillo Mountains, Puerto Rico https://www.treesearch.fs.fed.us/pubs/30048
https://www.fs.fed.us/global/iitf/pubs/ja_iitf_2006_covich001.pdf

Tree species distributions in relation to stream distance in mid-montane wet forest, Puerto Rico
https://www.treesearch.fs.fed.us/pubs/39463
https://data.fs.usda.gov/research/pubs/iitf/ja_iitf_2009_heartsill005.pdf

Vegetation https://www.treesearch.fs.fed.us/pubs/53155
https://data.fs.usda.gov/research/pubs/iitf/bc_iitf_2012_Hearstill001x.pdf

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

DEC 29 2016

El Yunque National Forest
Attn: El Yunque National Forest Plan Revision
Sharon Wallace
HC01, Box 13490
Rio Grande, PR

Dear Ms. Wallace:

In accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, the U.S. Environmental Protection Agency has reviewed the Draft Environmental Impact Statement (DEIS)(CEQ#20160215) prepared for the Revised Land and Resource Management Plan for El Yunque National Forest, Puerto Rico.

This DEIS, prepared by the U.S. Forest Service, describes and analyzes in detail the three alternatives for managing the land and resources of El Yunque National Forest. It describes the affected environment and discloses environmental effects of the alternatives.

Alternative 2 is the proposed action for the draft revised Forest Plan. It addresses public desire to access the forest for recreation, but recognizes carrying capacities and the need to maintain sufficient infrastructure to support visitation. It shifts recreational opportunities to the lower elevations of the Forest, which are better suited for recreational use. Alternative 2 would:

- Propose a new planning system based on ecological, social, and economic sustainability.
- Recognize the need to protect and restore the functional wetlands that occur over 600 meters in elevation and increase forest vegetation types from 4 to 15 to reflect the new vegetation classification system and the Forest's most recent findings.
- Promote recreation sustainability, and address increased demands and needs by promoting recreation at lower elevations in a setting closer to local communities.
- Introduce plan components for environmental education, collaboration, and ecosystem services.
- Establish nine management areas including a new scenic byway corridor for PR 186.
- Establish three geographic areas (El Norte, El Este, and El Oeste and Sur) to increase community interactions and an "all-lands" approach to planning.
- Establish a community interface resource management area (CIRMA).
- Create an expanded management area for the purpose of research and long-term watershed studies.
- Remove direction for managing species as management indicator species and replace it with species of conservation concern.
- Provide additional management direction for priority watersheds using the national watershed condition framework.

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All native ecosystems and native species, including at-risk species, would be protected. The Forest would continue to provide open space and natural settings, as well as an array of goods and services that are important to nearby residents and various communities of interest. Under the draft revised plan direction, recreation activities would be dispersed to lower elevations of the Forest, alleviating some of the existing pressure of intense use along PR 191, and ultimately allowing for more sustainable levels of recreation throughout the Forest and satisfying a broader range of recreation values and interests.

The DEIS should include a more detailed description of how the scenic byway will be constructed. Is construction required or will you only designate a 600-meter band of the PR 186 right-of-way? If construction is required, you need to include specific plans for such in a revised DEIS. If such information is available elsewhere, please provide it to EPA and at a minimum, incorporate the material by reference in any revision. Based on how the document is currently written, it appears that no new construction will be required for the PR 186 byway.

If there is potential for landscaping, EPA's GreenScapes program provides cost-efficient and environmentally friendly solutions for landscaping. For additional information, please see: http://www2.epa.gov/greenerproducts/identifying-greener-landscaping-choices.

Use of diesel equipment will be required during project activities. Clean diesel options should be considered. For new equipment, utilize contract specifications requiring advanced pollution controls and clean fuels; please see: http://www.northeastdiesel.org/pdf/NEDC-Construction-Contract-Spec.pdf and
http://www.epa.gov/cleandiesel/technologies/index.htm.

Consider implementing diesel controls, cleaner fuel, and cleaner construction practices for on-road and off-road equipment used for transportation, soil movement, or other construction activities, including:

- Strategies and technologies that reduce unnecessary idling, including auxiliary power units, the use of electric equipment, and strict enforcement of idling limits; and
- Use of clean diesel through add-on control technologies like diesel particulate filters and diesel oxidation catalysts, repowers, or newer, cleaner equipment.

For more information on diesel emission controls in construction projects, please see: http://www.northeastdiesel.org/pdf/NEDC-Construction-Contract-Spec.pdf.

Thank you for the opportunity to comment on the DEIS prepared for the Revised Land and Resource Management Plan for El Yunque National Forest, PR. EPA rates the DEIS as EC-2 or "Environmental Concerns" and "additional information needed" in accordance with EPA's national rating system; primarily due to our questions about the byway corridor.

Our comments on the DEIS contained in this letter are intended to help provide useful information that will ultimately inform local, state and federal decision-making and review related to land and water resource use and impacts. Should you have any questions regarding the comments and concerns detailed in this letter, please feel free to contact Michael Poetzsch of my staff at 212-637-4147.

Sincerely,

Judy-Ann Mitchell, Chief
Sustainability and Multimedia Programs Branch
Clean Air and Sustainability Division

Comments on the Draft Management Plan for the El Yunque National Forest

Sheila Ward:

To the Team preparing the El Yunque Draft Management Plan:

First, I want to congratulate the team on an excellent product integrating inputs from so many groups and information sources. I also want to raise some points for your consideration. Points 6 and 7 were developed based on communications with Frank Wadsworth and Nicholas Brokaw.

1. The plan does not mention certain research projects that are not in the designated research areas. These would include- 1) genetic trial and gene bank for a large mahogany study, 2) the arboretum located near Carr. 186 3) long term study sites such as the 400 series plots, and the Palm, Colorado, and Tabonuco plots. It would be good for EYNF to have a registry with the locations of all study locations in the forest. The Management Plan could refer to this database, and it should be accessible to the planning team.
2. I think there needs to be an intent for more inclusivity for recreation opportunities for people with disabilities.
3. Pg. 30: It would be good to emphasize more the potential for recreational development in MA4 zones. Only dispersed camping is mentioned. I think there are areas in this zone that would potential for development as small group camping sites. I am not sure you actually want people camping anywhere in the forest on non-established or non-designated sites. High rainfall can result in high impacts, even in more level areas. The Asociación de Acampadores of Puerto Rico would be able to help evaluate areas for camping and hiking in MA4.
4. El Toro Wilderness Area: No mention is made of the LAC committee for the wilderness area that met in 2011. A final report was produced, which Jose Ortega should have. Several of points on Pgs 32-35 coincide with the recommendations of the LAC committee.
5. 3.2.2 Broader Landscape and Lands: Why are not lands along the Rio Mameyes outside of the forest perimeter also being considered for acquisition. This river has wild and scenic status within the forest, but no protection outside the forest boundary. It is about the most pristine river in Puerto Rico. In general, the protection of watersheds/riparian zones outside of the forest needs more emphasis.
6. I believe the draft plan needs to include a component on addressing research needs at EYNF. Forest managers will have an idea of further research needed to inform management. An outline or examples of these research needs should be included in the plan, with the general direction indicated and general prioritization of research needs. This would indicate that managers know that not all information is at hand, but a plan is at hand for progress. I believe that the plan should also include the intent to form a scientific advisory committee, to promote the agenda of needed research in the academic community. Intention for an efficient permitting process should also be indicated, to help the needed research move forward in a timely way.

7. The draft plan and the EIA have taken a detailed look at the information available on target species. But I think one of the priority research needs is more biological inventory, including geolocation and habitat characterization information, reproductive information, food dependencies, interspecific relationships. This is particularly true for the El Toro Wilderness Area, to know more about the occurrence and sustainability of sensitive species in relation to potential human use. More extensive inventory research would be ideal for undergraduate and graduate research projects and could be promoted by the scientific advisory committee suggested in Point 6, at various institutions in and out of Puerto Rico.
8. In general, the partnership needs to be better developed between EYNF and the academic community, in addition to partnerships with local communities and other stakeholder groups.
9. 3.2.2 Broader Landscape and Lands – Objectives- should also list something about acquiring lands to protect the Rio Mameyes, and rivers other that the Rio Espiritu Santo.
10. Page 4 of the Environmental Impact Statement: The reasoning for not pursuing wild and scenic status for additional rivers in El Yunque is weak, it states that there is little public interest in this. I believe that the public is not conscious of this option.
11. Page 21 of the Environmental Impact Statement. I am sure there are more than 166 species of animals in EYNF. The arthropods probably need a lot more study.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Richard B. Russell Federal Building
75 Ted Turner Drive, S.W., Suite 1144
Atlanta, Georgia 30303

ER 16/0546
9043.1

December 28, 2016

Pedro Rios, Project Leader
USDA Forest Service
HC-01, Box 13490
Rio Grande, PR 00745-9625

Re: Comments and Recommendations on the Draft Environmental Impact Statement (EIS) for El Yunque National Forest Plan Revision, Puerto Rico

Dear Mr. Rios:

The United States Department of the Interior (Department) has reviewed the Draft Environmental Impact Statement (EIS) for El Yunque National Forest Plan Revision, Puerto Rico. We offer the following comments for your consideration.

National Landmarks

The El Yunque National Forest contains a designated National Natural Landmark, Bano de Oro Natural Area. Bano de Oro Natural Area, it is not identified as a National Natural Landmark in the Draft EIS. The Bano de OroNatural Area was designated a National Natural Landmark in 1980 and encompass nearly 1,700 acres. Containing virgin forest, Bafio de Oro Natural Area is the only contiguous area in Puerto Rico that contains subtropical wet forest, rain forest, dwarf forest, and Pterocarpus. The site also supports many endemic plant and animal species.

The National Natural Landmarks Program recognizes and encourages the conservation of sites that contain outstanding biological and geological resources. Sites are designated by the Secretary of the Interior for their condition, illustrative character, rarity, diversity, and value to science and education. The National Park Service administers the program and works cooperatively with landowners, managers and partners to promote conservation and appreciation of our nation's natural heritage. To date there are nearly 600 landmarks designated nationwide.

We recommend including this designation when discussing Bano de Oro Natural Area in the

El Yunque National Forest Plan Revision – ER 16-0546

Draft EIS. For more information regarding this significant designation please visit our website at www.nps.gov/subjects/nnlandmarks or contact Carolyn Davis, National Natural Landmarks Coordinator at (717) 338-4458, or email at carolyn_davis@nps.gov.

Moreover, the USDA Forest Service (USFS) is proposing to revise the Land and Resources Management Plan for the Caribbean National Forest and Luquillo Experimental Forest. The proposed action addresses the planning, collaborative, sustainability, social, economic, and ecological needs that have been identified in the draft revise Plan.

El Yunque Forest Plan Revision includes 3 alternatives, where Alternative 2 is the preferred alternative and proposed action. Alternative 2 addresses public access for recreation but recognizes carrying capacity of the area for visitation. It also addresses climate change impacts and monitoring of its effects. In addition, the USFS would improve desired conditions by developing standards and guidelines and management activities that would provide landscape connectivity.

According to the DEIS and information in our files, El Yunque National Forest harbors suitable habitat and populations for 14 federally listed species. The effects of proposed actions on those species should be evaluated in a Biological Assessment (BA). We acknowledge that USFS is drafting a BA for this project to address listed species and we have been providing technical assistance on that regard. Any site-specific project, action, or special permit with the potential of affecting federally listed species, and not covered by the BA will need an individual consultation under Section 7 of the ESA.

After reviewing the DEIS, we provide the following comments and recommendations:

1. The species mentioned in table 3-18 (federally listed fauna) and in Section 3.4.3.5 (federally listed flora) are all the currently listed species under our jurisdiction. There is no additional listed species to be included. The DEIS mentioned that the elfin-woods warbler is a proposed threatened species. The elfin-woods warbler is already listed as a threatened species since June 22, 2016 (81 FR 40534). We are currently working on the Final Critical Habitat designation for the species and it is expected to be finalized for June 2017. One of the proposed critical habitat units is within the El Yunque National Forest.

2. For the Department, "at risk species" is a terminology for species that have either been, petitioned for listing, are candidates for listing or are proposed for listing under the ESA; in addition to other species deemed as species of concern (species with low or declining populations) by the States or Territories. The DEIS only includes fauna (wildlife) as "at-risk-species". We recommend the USFS reviews the list of at risk species develop during the workshop conducted in IITF in February 2016, and determines from that list the species that occur at El Yunque National Forest.

El Yunque National Forest Plan Revision – ER 16-0546

3. The DEIS frequently refers to the 2014 Forest Plan Assessment in regards to listed species and its habitat; however, there is no link to the document. We recommend providing a link to the document to be able to refer to it.

4. Alternative 2 proposed a recreation corridor- a scenic byway along PR Road 186 that would create recreational activities at lower elevations of the Forest. The DEIS suggests that this new scenic byway would help improve a variety of habitat for various species (including the sharp-shinned hawk) and provide a link between the Forest and the coastal region of northeast Puerto Rico since they would provide management efforts to restore ecological functions after a natural disaster. Based on the available information we cannot concur that the proposed action may benefit listed species (i.e., sharp-shinned hawk, broad-winged hawk, elfin-wood warbler) since these species are habitat specific (e.g., found in mature forest and bounded by elevation) and their range does not include coastal forest. In addition, as indicated in the DEIS, the scenic byway would increase vehicular use over time; thus, it is expected that there would be an increase in disturbance from vehicular and human presence in any rehabilitated recreation site. We recommend that this proposed action be carefully evaluated in the BA.

5. The latest information on the status of listed species may be found in the 5 year status review documents at http://ecos.fws.gov/ecp/ or https://www.fws.gov/southeast/5yearReviews/5yearreviews/. This information would be useful for the development of the BA.

Thank you for the opportunity to provide comments on this project. It is our mission to work with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of our people. If you have any questions or require additional information, please contact Maritza Vargas at (787) 851-7297, extension 215. I can be reached at (404)331-4524 or at joyce_stanley@ios.doi.gov.

Sincerely,

Joyce Stanley, MPA
Regional Environmental Officer

cc: Christine Willis – FWS
Michael Norris – USGS
Anita Barnett – NPS
Esther P. Kia'aina – Insular Affairs
OEPC - WASH

3

QUICK REVIEW OF EL YUNQUE FOREST MANAGEMENT PLAN

Peter L. Weaver (former research forester)

(November 28, 2016)

INTRODUCTION

Background -- Weaver did both his MS and PhD research in the forests of El Yunque. He wrote some 50 papers about the forest, including one each on the Baño de Oro Research Natural Area and the Wilderness Area, neither of which is cited in the references for the El Yunque Management Plan. Many national forests do not have this information. It seems that a management plan would want to highlight what is known for interested readers.

EYNF (El Yunque National Forest) has piles of information on plants, animals, and the environment, probably more than any other national forest. EYNF has a unique research-management relationship and is the only tropical forest in the system, but introductory statements gloss over what that means. Should it be pointed out better? On a small, unique piece of property like the EYNF, managers should be advised to act cautiously. Astute planners should question a heavy reliance on traditions, rules, and formats developed for larger pieces of land in the temperate zone. Trying to do everything on a small piece of land is not advisable.

From 1968 through 2012, Weaver had hiked, often alone and most frequently cross-country (not on trails), as follows: (1) from El Verde Station to El Yunque Peak; (2) from El Verde Station through the forest to the El Toro Trail entrance on route 191; (3) from the entrance of East Peak Road to Rio Fajardo; (4) Down the south slope of Rio Blanco to the water retention dam at 2000 feet; (5) along the El Toro Trail from route 191 to 186; (6) to the summits of El Toro, El Cacique, and La Mina peaks; (7) to the Valley of the Giants; (8) up and down and all around both the East Peak Radar dome and the El Verde Field station; (9) along several portions of the old East Peak Trail; and (10) throughout the Baño de Oro Natural Area several times. In addition, hikes were made on numerous occasions to 24 permanent plots in different forest types, to the airplane wreck near East Peak, many of the 400 subplots in the four 100-plot studies, to another 132 temporary plots in the study of El Yunque's forest types, and with students to different sites in all forest types. Weaver has also lived at four different locations within El Yunque for a total of nearly one year.

Purpose – Review of the El Yunque draft forest management plan was requested by EYNF through the local newspapers. This is a review of portions of the plan. The job is to consider what seems appropriate, make observations, ask questions, and forward suggestions. The review is in plain English. If there are questions, please contact me. Also, my comments submitted on the last version of the EYNF management plan were either discarded or lost. I was forced to rewrite them and submit them again on June 9, 1995. I would be grateful if these comments were not subjected to a similar fate.

MANAGEMENT PLAN COMMENTS AND QUESTIONS

Philosophy:

- **What If** – Let's suppose that a block of absolutely undisturbed land with the same dimensions and attributes as the island of Puerto Rico were available for management planning (cities, roads, forest reserves, etc.). What would the planners do with the small piece of land (about 1% of the island) known as EYNF with its limited size, natural beauty, endemic plants and animals, rare and endangered wildlife species, scenic vistas, and abundant water. The entire land mass might be set aside for public benefit. Just think about that for a moment. That thought should always be in the back of a local planner's mind. Development should not damage a country's heritage or its natural resources so that humans can have fun. That's not management. Protect the forest, first and foremost, as a forested unit and not as a developed playground.
- **Money** -- The U.S. government is broke. As part of the national debt, Time magazine says that every citizen of the USA owes the government $43,000. Therefore, it's not recommendable to propose costly, money-losing projects. In fact, it's our duty as citizens to manage wisely, to see that our great nation doesn't "perish" from the earth.
- **EYNF Values** -- The most important values and uses of EYNF are for wildlife (plant and animal) protection, water supplies, passive recreation, and environmental education. All of these functions have greater value than disturbing the environment for other purposes.
- **Change and Future** -- Global warming is real and forest protection is imperative. Scientists, despite their models, are unsure what will happen. Planners should not help global warming by disturbing forest cover or forest borders to please what some perceive as human desires. Don't fragment the EYNF. Protect it as a block of tropical forest.
- **Feasibility** -- Is the EYNF plan a wish list? Propose what is correct and possible. Then prioritize feasible activities and make sure that they are done.
- **Tree Cutting** -- Timber harvest should only be carried out if the government makes money, and simultaneously, other more meritorious objectives are implemented (for example, restoration of lowland tabonuco forest, an endangered forest type). *Many of the favorite timber species for artisans are relatively rare.*
    - It took about 70 years of reforestation and succession to achieve decent forest recovery at the base of EYNF.
    - Logging means fragmentation, road damage, soil disturbance, impacted water supplies, economic studies, accounting, field supervision, possible damage to future parrot habitat, and so on. Do economic studies describe probable environmental impacts? How about a guaranteed profit for the government?
    - Cut for what purpose? Demonstration is not a justifiable reason. Making money is. Is there any money to be made? Is cutting EYNF worth the effort?
    - Support timber cutting on managed properties outside of the EYNF. The EYNF is practically sacred to many folks on the island. Let's keep it that way. Forests outside of the EYNF could be cut by private owners. Can EYNF help them?

Editorial (bunch of questions):

The document appears to be a pasted pile of papers. Here's the question always asked of researchers – *is this the best job that you can do*? *Did anybody read it from cover to cover?* The document needs a *knowledgeable writer with all important materials who can also edit*, and with access to a lab to produce standard figures and tables. Otherwise, a comprehensive, well-organized, and readable document won't be ready for a while. Some questions:

- Does EYNF have anybody on its staff who has publication experience? A good writer writes and edits continuously, thus, he or she really doesn't need an editor. What can editors do? Editors can only do a job if all of the relevant material is within the document (can't edit what isn't there). Is all relevant information there?
- Has the current EYNF staff studied the comments made on the last management plan (after 1990)? They were written about the same forest.
- Who is the plan for? What do you want to tell them? Is the document written in such a manner that the audience will want to read it (at least certain sections)?
- Should the document assume that the reader does not know Puerto Rico? Should it contain a locator map in the beginning for orientation, showing El Yunque boundaries, major roads, and major towns?
- Would the document be better if the information were in easier to read format? Are all tables and figures really needed? Should they have a standard format? Should some be omitted or combined? Is all repetitive text really necessary, or could some of it be presented more efficiently in tables or in figures?
- Is the document in metric or English units? Is it appropriate to jump back and forth in text, tables, and figures within the same document?
- Should the figures be legible and completely labelled? Should each have a north arrow and scale of miles, kilometers, or both? Should there be some discussion in text of what appears in the figures so the readers know precisely what they are looking at? Should print be standardized along with (font) size and colors?

Some Thoughts, Concerns, and More Questions:

- **Planning Process** -- The involvement of "appropriate agencies" (Federal and Commonwealth) in EYNF planning was mentioned in a EYNF meeting held years ago on the forest. Weaver questioned, should the EYNF staff plan in conjunction with state and other Federal agencies on the island? The reply ran something like this -- "it's doubtful that will ever happen." The statement was made by a visitor from the regional office. Does the USFS plan in conjunction with other Federal and state agencies? Would Puerto Rico, which has an area equivalent to a square 58.5 miles on a side (about 70% of metropolitan Los Angeles), not benefit from good cooperative planning?
- **Tourism** -- Does the Tourism Company promote Puerto Rico's 15 Commonwealth forests and 13 or so Conservation Trust properties, along with other potential tourist sites? Is El Yunque the only well-advertised landscape on the island? Spreading the visitor load around different sites could help during times of maximum use. Has anybody in EYNF talked directly with Tourism and expressed concerns?

- **EYNF Size** – Is the forest large enough to survive uncertain global warming changes? Will any of the proposed management interventions (logging, and borderline recreational activities) cause potential long-term damage? Will these activities fragment the forest boundary? *Fragmentation, itself, introduces changes in climate and may compound the global warming problem on the forest.*
- **Uniqueness --** EYNF has more tree species than any national forest in the USA; also, more rare and endangered plants and animals. Some 99.6% of the island has been cut at one time or another, so the EYNF is very important as a block of forest. On the island, and within the EYNF, more tabonuco forest has been destroyed than any other type. The amount of so-called "novel" (secondary) forest inside EYNF boundaries substantiates that claim. Lowland tabonuco forest is a relatively rare. Should it be restored at lowest elevations where tree size and plant diversity were the greatest in the past?
- **Literature --** The reference section of the management plan does not reflect the amount of work that has been done in the forest. At least two citations are repeated. Should readers have a better idea of what is known?
- **Congested Forest --** EYNF sometimes is seriously overcrowded, destroying any notion of being in a forest environment. There is illegal road parking (often blocking the East Peak Road) and garbage strewn about. Should crowding be controlled for the sanity of people who go there because they love the forest?
- **Interpretation** – Could a much better "interpretation" job be done in the forest and in El Portal? Could existing signs be improved and better maintained? Could more (different) information be presented at the El Portal? Improving this aspect of EYNF, however, is extremely difficult. Management has shown minimal interest.
- **Recreation Trails --** More recreation trails are suggested for the forest borders. EYNF cannot maintain the current system. Will more trails encourage more motorcycles, mountain-biking, and disturbance along the lower forest boundary. The Angelito Trail is an example of a new trail in bad condition. Shortcuts have destroyed parts of the trail.
- **Past Recreation Trail** – EYNF reopened a trail from the southern recreation site on route #191 so that people could enter the forest from that point. As Weaver recalls, that trail "re-reconstruction" deviated in areas from the old trail, and led hikers into the Wilderness Area. EYNF cannot maintain its current trail system. Are more trails advisable?
- **Development and Species** – Several times in the report a statement something like "development will improve aquatic habitat and more native species." Could somebody please explain how human use of riparian sites will achieve that objective?
- **La Mina Falls** – Use of La Mina Falls should be restricted for safety reasons. Bathing at should be prohibited (flash floods, slippery rocks). Kenah Huggins slipped on wet rocks and died there on August 26, 2012. Weaver has seen people bathing babies (under 1 year) at La Mina Falls. More drownings could happen. Carting ice boxes to the Falls should be prohibited for garbage control (Scenic and Wild Rivers). Advertising the La Mina as a swimming hole all over the world should stop. Bathing at lower elevations and guided tours at Big Tree Trail should substitute for dangerous aquatic activities.

- **New Lands** – Acquiring new lands on the forest border sounds good. But why? To consolidate the EYNF some might say. However, the plan proposes to link new trails and border area recreation sites to communities. That's not consolidation but fragmentation. The plan here is confusing – buy land to consolidate and simultaneously fragment border areas for recreation sites and trails. EYNF cannot manage the recreation areas and trails that it has now. Making more sounds inadvisable.
- **Parrot** – Somebody has declared that EYNF is not preferred habitat for the Puerto Rican Parrot. Therefore, that makes it okay to cut trees, develop recreation sites, and make new trails to communities along the border, and so on. If that is done, will the parrot ever return to lower elevation tabonuco forest? The parrot thrived there during the 18th, 19th, and into the early 20th centuries, until loggers cut nesting trees and food sources. Trees take time to grow and parrots need old trees. With current parrot planning, the central and western part of the island will ultimately have parrots but not the east (the place where they survived). Should EYNF not encourage recovery of the tabonuco forest with its native species as future parrot habitat? How could this be best done?
- **Airplanes --** Noel Snyder suggested prohibiting planes from flying at low elevation over the forest. That idea may benefit the parrots, but it's even a better idea for the survival of local pilots. EYNF has had five plane crashes since the 1940s. Is it safe to fly at elevations lower than the mountain tops? On five occasions pilots showed that it wasn't!
- **Camping** – Garbage and the introduction of alien plants are associated with campers. Camping below clouds that dump 180 inches per year can be slightly uncomfortable for most people. How do garbage and introduced plants help pristine forest?
- **All lands Approach** – Not sure that the concept is easily understood. All lands where? On the forest border or on the entire island? The second makes more sense but the comment made by the regional visitor (see planning process paragraph on page 3) seemed to indicate otherwise.
- **Poverty** – Is Puerto Rico poor? It doesn't look that way when one compares it with the rest of Latin America. Islanders eat well, have access to welfare, cell phones, TVs, vehicles, and so on. The island has a pleasant climate. Does anybody freeze to death in the winter? Politicians talk poverty all of the time looking for more money.

Brief Summary – Philosophical and editorial comments along with thoughts, concerns, and questions regarding the document were mentioned above. EYNF belongs to all the people of Puerto Rico -- those who live along the EYNF border and those who don't. To some, EYNF is almost sacred. Management ideas devised in the USA for large, species-poor temperate zone national forests should not be transplanted verbatim to a small, unique, species-rich tropical forest with an abundance of rare and endangered wildlife (plants and animals) and critical water supplies. The effects of global warming are real and crucial. Border fragmentation is unwise and non-reversible. Poor decisions regarding border integrity won't help conserve EYNF during global warming. Improved environmental education will require dynamic, well-versed biologists (foresters), who know the EYNF on the ground.

5

The following comment letter addresses the proposal for the introduction of extinct fauna species on El Yunque National Forest. The proposed species include a few mammals, the white-necked crow, the red-footed tortoise, among other species, along with background information on each of these species.

RETORNO AL FUTURO: EL YUNQUE

Y LA FAUNA PERDIDA DE PUERTO RICO

Francisco Watlington Linares, PhD.

Catedrático de Geografía

Universidad de Puerto Rico

RESUMEN

El Yunque es la mayor reserva forestal de Puerto Rico. Es manejada por el gobierno de Estados Unidos siguiendo una política pública conservadora que no ha reconocido la deseabilidad de restaurar la fauna perdida por el desgaste ambiental antropocéntrico. Se propone un desglose de especies apropiadas para la reintroducción a fin de rehabilitar la biodiversidad del bosque más críticamente importante del país.

Palabras clave: mitigación biogeográfica; translocación de especies claves

ABSTRACT

El Yunque is the largest forest reserve of Puerto Rico. It is managed by the United States government following a conservative public policy that has not recognized the desirability of restoring a faunal community lost by anthropic environmental attrition. A description of appropriate species for reintroduction is herein proposed toward rehabilitation of biodiversity of the island's most critically important forest.

Key words: biogeographic mitigation; translocation of keystone species

Introducción

El Yunque es el mayor bosque de Puerto Rico y el mejor custodiado por estar encomen-dado al gobierno federal como legado del gobierno español. El Yunque comprende unas 11,100 hectáreas de terreno. Protegido en parte desde 1876 por el gobierno español, contiene remanentes de vegetación primaria imperturbada (López marrero y Villanueva Colón 2006). Ambas administraciones concibieron El Yunque como reserva forestal de árboles maderables. Con el tiempo reconocieron su valor como fuente de agua potable y refugio de vida silvestre. Sin embargo, el perdurable régimen colonial impone criterios de manejo propios de una ideología atávica que impide la restauración biogeográfica de la fauna perdida de Puerto Rico.

Especies a considerar

El caso más notorio es la renuencia de restituir la última especie en extinguirse, el cuervo de collar blanco (*Corvus leucognaphalus*) desaparecido a mediados del siglo pasado y fácil de reintroducir de la República Dominicana donde también son nativos.[1] El rotundo éxito del aviario Vivaldi en Río Abajo, Arecibo, del Departamento de Recursos Naturales y Ambientales (DRNA) en restaurar al estado silvestre la cotorra

jíbara (*Amazona vittata*) hace innecesario las costosas facilidades de aviario y laboratorio federal destinados a rescatarla. El desdichado proyecto mantiene las apariencias con subsidios de pichones de Río Abajo. (Watlington 2008).

Otro caso de fácil resolución es el de la tortuga terrestre de patas rojas (*Geochelone carbonaria*). Nativa de Venezuela, habría sido introducida por los indígenas y sigue naturalizada en Islas Vírgenes y otras Antillas Menores. Es reproducida en Estados Unidos e importada legal-mente para el mercado de mascotas. Su dieta herbívora incluye plantas, frutas, carroña, y hasta excremento de animales. Bastaría la iniciativa de algún grupo ambientalistas para reintroducirla.

Algunas especies de mamíferos cuadrúpedos arbóreos y terrestres que fueron elementos notables de la antigua fauna puertorriqueña todavía abundan en Suramérica y podrían ser objeto de introducción planificada. Se destaca el perezoso "de dos dedos" (*Choloepus hoffmanni*), o sea de dos garras por brazo con los que trepa y se sujeta de las ramas de su árbol favorito, el yagrumo (*Cecropia peltata*) cuyas hojas lo alimentan. Es tan manso que en Venezuela los mantienen como mascotas virtuales en parques y plazas urbanas. Son muy aseados, bajando semanalmente de su árbol residencial para depositar sus carrutas de excremento al pié del mismo. Su presencia en la Isla antecede por millones de años la de los aborígenes que acabaron con ellos.[2]

Diversos géneros de roedores caviomorfos terrestres de la América tropical fueron endémicos o naturalizados en el Puerto Rico prehistórico (Watlington 2003). El más conocido es la jutía (*Isolobodon portoricensis*), especie domesticada en La Española e introducida por los aborígenes a la Isla donde se asilvestraron. Su tamaño apetecible adulto de sobre 2 kg (5 lbs) lo condenaron a la cacería que acabaría con ellos a comienzos del siglo pasado. El rol ecológico que habría realizado es la dispersión de semillas de árboles frutales y palmas que almacenaban enterrándolas y luego olvidaban. Sus parientes más cercanos del mismo porte y hábitos son los agutíes de Suramérica y las jutías caprómidas de Cuba. En los parques urbanos del continente los mansos animalitos mendigan migajas de los visitantes con el beneplácito de las autoridades pues contribuyen al aseo público.

A todas luces las ratas espinosas suramericanas llegaron a la Isla en canoas aborígenes. Cumplían las mismas funciones ecológicas que las ratas euroasiáticas que las desplazaron. Se cebaban en las hortalizas para acabar en el puchero indígena. Aunque la taxonomía tradicional le adscribía nomenclatura endémica, un estudio reciente integra la nativa a la especie suramericana (*Proechimys semispinosus*) más común (Watlington Linares 2007). No está claro si realmente se ha extinguido, pues hay indicios de poblaciones remanentes en islitas periferales. Cualquiera puede distinguirlas de las ratas comunes actuales sobándolas para sentir sus finas espinas.

El roedor caviomorfo endémico más grande (sobre 10 kg) que hubo en la Isla lo fue el castor puertorriqueño, que habitó los humedales, ríos y quebradas del país incluyendo El Yunque. Se estima que el antepasado de *Elasmodontomys obliquus* llegó por la corriente ecuatorial del Atlántico norte en balsa de vegetación expulsada por el paleo-río Niger hace más de 25 millones de años cuando la separación entre África y América era la mitad de lo que es actualmente.[3] Sus osamentas aparecen en depósitos paleontológicos pero escasean en yacimientos aborígenes tardíos, lo que supone una temprana extinción a manos de los primeros humanos en llegar al país.

Por extraño que parezca, existen algunas especies de roedor caviomorfo de tamaño y biogeografía similar al castor endémico extinto. Uno es el capibara (*Hydrochaeris*), herbívoro de los pantanales descampados. El otro es el coypu (*Myocastor coypus*), la única especie de la familia de jutías caprómidas antillanas nativa de Suramérica.

Existen varias especies de roedor caviomorfo de tamaño y biogeografía similar al castor endémico extinto. El de afinidad más ancestral podría ser el coypu, la única especie de la familia de jutías caprómidas antillanas nativa de Suramérica y translocada por humanos a Estados Unidos, Europa, Asia y África (Macdonald 2006; Felipe 2008). En el viejo mundo ha sido domesticado por la calidad de su piel, donde poblaciones cimarronas se han naturalizado con mucho éxito. De los caprómidos antillanos que aún existen se destacan las jutías grandes de Cuba con peso adulto de 8.5 kg (casi 20 lbs). La mayor y más común es la jutía conga (*Capromys pilorides*) con subespecies que prefieren merodear los cursos de agua en áreas de bosques. Del mismo tamaño es la jutía arbórea de rabo prehensil (*Mysateles prehensele*). Ambas especies son mansas vegetarianas con suplemento de insectos y lagartijas ocasionales y domesticables. Los roedores caviomorfos producen un pequeño número de crías precociales. Nacen con ojos abiertos, pelambre adolescente y hábiles al caminar. Aunque la madre los lacta por un tiempo, si un humano interviene para alimentarlos lo aceptan como nodriza y se domestican por impronta ción.

El caviomorfo continental más prometedor, aparte del coypu, como reemplazo del castor boricua es sin duda la paca (*Agouti paca*) cuyos adultos promedian 13 kg (más o menos 30 lbs). Es el roedor de caza más apreciado por su carne que se compara con la de ternera. Vegetariano, hace sus madrigueras en las márgenes de riachos y quebradas en los bosques. Animal manso, fácilmente domesticable por impronta ción aunque no es muy prolífico.

De antigüedad comparable al castor criollo es el pequeño carnívoro *Nesophontes edithae*, que habría llegado desde África occidental balseando para la misma época sino antes. Pertenece a la orden Tenrecoidea con las musarañas-nutrias de África occidental (*Potomogale velox*) y Madagascar (*Limnogale mergulus*). Ambas especies son tan pequeñas como el *Nesophontes* de aquí (300 a 950 g) y viven en cursos y cuerpos de agua dulce donde se alimentan de insectos, sapos, moluscos, cangrejos, peces y camarones. En sus regiones de origen se ven amenazados por el desmonte y la contaminación de las aguas.

El último mamífero terrestre de la fauna perdida de Puerto Rico es el más problemático de confirmar porque la evidencia de su existencia es circunstancial. La presencia de monos neotropicales (platirrinos) en todas las Antillas Mayores menos la Isla ha sido comprobada para la misma época en el Mioceno, hace 26 millones de años, que aparecieron en Suramérica, proveniente sin duda de África por el mismo corredor que balsearon los roedores y musarañas. ¿Pasaron de largo la Isla, la primera recalada firme de la corriente ecuatorial del Atlántico norte?

¿O se trata de prospección paleontológica y arqueológica deficiente? Presumiendo lo último, hay razones de peso para postular la necesidad de tener especies de monos inofensivos de América que ocupen la vacante biogeográfica amenazada por los problemáticos Rhesus asiáticos (*Macaca mulatta*) con una poblacion cimarrona naturalizado en el oeste de la Isla.

Los monos neotropicales, o sea de América, son vegetarianos, alimentándose mayormente de frutas, hojas, nueces y resinas (Macdonald 2006). Con una excepción todas las especies son de hábitos diurnos, fáciles de observar y manejar. Los de mayor tamaño son los aulladores del género *Alouatta* (hasta 8 kg. ó 15 lbs) con especies desde el sur de México hasta la gran cuenca amazónica. Sus rugidos mantienen la separación territorial de sus clanes y facilita su localización. La mitad de su alimentación es el follaje tierno de árboles y el resto frutas y sabandijas. Curiosamente, el presumible ancestro de las especies de tierra firme continental lo sería el *Paralouatta* del Mioceno de Cuba.

Los monos capuchinos del género *Cebus* (2 a 4 kg. 5 a 6 lbs) son los más inteligentes y versátiles de los primates americanos. Utilizan herramientas rudimentarias para obtener la mayor diversidad de alimentos de cualquier otro mono neotropical. Su amplia distribución es compartida en alianza mutualista con el asustadizo monito ardilla (*Saimiri sciureus*) que pesa entre 600 gr y 1.4 kg (1 a 2 lbs). Bandas de cada

especie comparten la búsqueda de alimentos, sirviendo los *Saimir*i de centinelas que aprovechan los bocadillos expuestos por los capuchinos. El consorcio de ambas especies ocuparía la vacante biogeográfica de los primates y sería fácil establecer porque ya existe una presumible especie endémica de mono ardilla naturalizada en Puerto Rico.

Interesantemente, el ancestro de los monos ardillas modernos podría haber sido el *Antillothrix* de La Española del Mioceno. La nueva especie criolla surgió de un incidente a principios de la década de 1970 en el Centro de Primatología de la Universidad de Puerto Rico en Sabana Seca, Toa Baja. Aunque protegido por una cadena de mogotes impenetrables en un rincón cercado de la base naval, los laboratorios del Centro fueron escalados en horas no laborables por vándalos que no contentos con el robo de equipo abrieron las jaulas exteriores de los monos Rhesus y ardillas residentes permitiendo su fuga.

Al día siguiente los científicos se toparon con una escena insólita. Los inteligentes Rhesus esperaban impasibles su desayuno dentro de las abiertas jaulas. Los monitos ardilla por el contrario habían huido en masa a la libertad de los mogotes atizados por su instinto básico.

Aquí comienza una épica evolución biogeográfica. Resulta que los monitos en fuga pertenecían a dos subespecies distintas de *Saimiri*, diferenciables por su apariencia. *Saimiri sciureus* provenía de Guayana y es nativa de la mayor parte del norte de Suramérica. Al extremo oeste de la misma región en el piedemonte andino es parapátrica con *S. oerstedii,* la otra especie fugitiva con la que es interfértil.

Evidentemente ambas especies, o si se prefiere subespecies, se acomodaron a la vida compartida y se hibridaron. La selección ambiental y sexual se encargó de generar la población actual observada por los primatólogos del Centro. Casi medio siglo de naturalización ha consolidado el endémico *Saimiri portoricensis* a despecho del atavismo paradigmático colonial que niega su existencia por las autoridades federales y sus edecanes estatales. Nuestro monito ardilla debe ser translocado de su "isla" de mogotes a El Yunque donde cumpliría su destino en el remplazo de la fauna perdida.

NOTAS

1. Como joven explorador de la tropa 91 de Niños Escuchas tuve el privilegio de observar la última bandada de unos cincuenta cuervos mientras acampaba a orillas del alto Río Espíritu Santo a principio de los años 1970. Su desaparición posterior es un misterio sin resolver.

2. La formación Juana Díaz de Yauco confirma en su estratigrafía la existencia del perezoso *Acratocnus,* casi idéntico en tamaño y anatomía a la especie megalonichyda moderna. Su presencia en el Oligoceno temprano, 30 a 35 millones de años antes del presente lo convierte en el primer mamífero cuadrúpedo terrestre en colonizar la Isla. De aquí llegaría por balsa a las demás Antillas Mayores evolucionando a formas de mayor tamaño hasta llegar a Norteamérica donde derivó en especies gigantescas que emigraron a Suramérica cuando se conectaron por Panamá ambos continentes.

3. La distancia actual entre Recife, Brasil y Lagos, Nigeria ("enchufe" original de ambos continentes) es de 4,545.94 km. La distancia antigua era 2,273 km. La distancia entre Mayagüez y Cancún, México, arribada continental más probable por el rumbo de la corriente caribeña es de 2,090 km. Pruebas con botellas a la deriva ("drift bottles") indican una traslación de 44 km./día, con duración de de 67 días (6 ó 7 semanas) para llegar a tierra firme. Sin embargo, el transporte faunístico en balsas y los insumos recíprocos desde los ríos de La Española y Jamaica reducen a un tercio en cada caso el tiempo necesario para la translocación de especies a entre dos a tres semanas por tramo. Animales vegetarianos en balsas de vegetación viajarían sin pasar hambre.

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Date submitted (SA Western Standard Time): 12/12/2016 11:33:31 AM
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Province/Region: [redacted]
Zip/Postal Code: [redacted]
Country: United States
Email: [redacted]
Phone:
Comments:

You have classified some lands as "Secondary," ecologically this means that this type of forest is developing into the original climatic forest but many new evolving forests include non-original species that have naturalized and are part of this new "secondary" forest thus they will become with time a mature forest that includes nonoriginal species creating a new type of forest. This new forest condition is term "Novel forest" in the most recent forest literature, why you do not term those forest as such??? Or is it that you plan to eliminate all individuals of all those species in such lands therefore attaining the original climatic condition??

The following comment letter is a concern from residents who own land adjacent to the Forest. Their concern was whether the proposed EIS somehow affected their land and the purpose to use the land for smale-scale farming and ecotourism.

Date submitted (SA Western Standard Time): 12/4/2016 7:31:06 PM
First name: Rafael
Last name: Nido Vazquez
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Title:
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State:
Province/Region: [redacted]
Zip/Postal Code: 0[redacted]
Country: United States
Email: r[redacted]
[redacted]
Comments:

Somos due?os de dos fincas que se encuentran en El Barrio Sabana de Luquillo del Yunque.

A. R?stica , predio de terreno de 16.30 cuerdas, inscrita en el folio 158 del tomo 29, finca numero 1,100.

B. R?stica, predio de terreno de 17.50 cuerdas, inscrita en el folio 253 del tomo 29, finca numero 1,099.

La propiedad fue tasada por Pedro Lu?s Jimenez de Fasr Appraisal Service, Inc. en abril 2002 el documento indica que la propiedad est? localizada en state road 983, km 6.2 (interior) La Viuda Sector, Sabana Ward, Luquillo, PR property code 149-000-007-08-001, county code number 72089, census tract number 7440- 1403.00, zoning B-I , agricultural use.

Queremos saber si nuestra propiedad en alguna forma de vera afectada por la declaraci?n de impacto ambiental propuesta?

Nuestro inter?s futuro es utilizar la propiedad para agricultura liviana y desarrollar un proyecto tur?stico ecoamigable.

Atentamente

Rafael J. Nido

The following letter was submitted from the Puerto Rico Electric Power Authority (PREPA). In it, they support the preferred alternative with some additional recommendations. First, they suggest that the Forest provide geo-referenced maps that show where historical or archaeological sites can be found as well as threatened and endangered species as an additional tool for planning. They recommend the establishment of mitigation banks outside of the Forest and the creation of independent non-government organizations to support management outside Forest boundaries. They also recommend the establishment of alarm and security systems in recreation areas adjacent to rivers and streams in case of sudden flash floods. The potential land-use conflict of a recreation site on the Forest (Sabana Rec Area), which is adjacent to the entrance to a PREPA facility, where visitors often cross to that area, is pointed out in this letter. Finally, PREPA presents their proposal for the installation of new underground lines.

CN 078-04479
REV. 02/14

ESTADO LIBRE ASOCIADO DE PUERTO RICO
AUTORIDAD DE ENERGÍA ELÉCTRICA DE PUERTO RICO

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APARTADO 364267
CORREO GENERAL
SAN JUAN, PR 00936-4267

21 de noviembre de 2016

Mrs. Sharon Wallace, Supervisora Forestal
El Yunque National Forest
HC-01, Box 13490
Rio Grande, PR 00745-9625

Estimada señora Wallace:

Atención Lcda. Gisela Delgado Pacheco, Alcaldesa Interina:

Comentarios a Vistas Pública
Plan de Manejo de Terrenos
Bosque Nacional del Caribe, El Yunque

El Sr. Francisco Perez, representante de la Autoridad de Energía Eléctrica (AEE) asistió a la vista pública celebrada el 6 de octubre de 2016 a las 6:00 p.m. en el Salón de los Alcaldes del Municipio de Las Piedras. El equipo de trabajo del *Forest Service*, encargados de la elaboración del Plan de Manejo, ofreció la presentación del proyecto a los oficiales de gobierno y al público presente.

El Plan de Manejo contempla la clasificación, conservación, manejo y aprovechamiento de los recursos naturales de la reserva forestal. Por igual, la identificación y selección de áreas donde se pueda desarrollar proyectos sostenibles y compatibles que propicien oportunidades económicas, ecológicas, sociales y científicas. La franja de terreno en evaluación comprende un área de 29,536 cuerdas y pertenece al Servicio Forestal de los Estados Unidos.

De acuerdo a la documentación presentada en la vista pública, la AEE no tiene objeción a la acción propuesta sin embargo se emite los siguientes comentarios para su consideración:

1. Recomendamos se integre en el plan de manejo mapas geo-referenciados de las áreas donde predominan las especies de plantas o vida silvestre con potencial interés para la conservación, amenazadas o en peligro. Por igual, la identificación de los yacimientos arqueológicos, vestigios culturales o históricos e información relevante que sirva de herramienta de planificación. Dicha base de datos serviría al propósito de educar la población, proporcionar información para

"Somos un patrono con igualdad de oportunidades en el empleo y no discriminamos por razón de raza, color, sexo, edad, origen social o nacional, condición social, afiliación política, ideas políticas o religiosas; por ser víctima o ser percibida(o) como víctima de violencia doméstica, agresión sexual o acecho, sin importar estado civil, orientación sexual, identidad de género o estatus migratorio; por impedimento físico, mental o ambos, por condición de veterano(a) o por información genética."

análisis y evaluación de proyectos públicos que sean compatibles en el área o para el desarrollo de propuestas de estudios científicos por entidades o instituciones públicas o privadas.

Además, toda información relevante que sirva de herramienta de planificación y desarrollo de proyectos por las agencias estatales.

II. Uno de los objetivos del plan contempla la adquisición de terrenos en los corredores de ríos que conecten "El Yunque" con los sistemas ecológicos marinos que rodean al bosque.

Alternativas

a. Recomendamos se fomente la creación de asociaciones independientes sin fines de lucro. Estas pueden elaborar programas o proyectos relacionados a la protección y/o rehabilitación de las cuencas ribereñas mediante adquisición de terrenos. Igualmente, recibir aportaciones o donaciones por entidades públicas o privadas con fines de conservación del ambiente. El propósito fundamental de estas asociaciones sería la conservación del recurso acuático, regeneración y preservación del ecosistema, aprovechamiento y disfrute de los visitantes y turistas e incremento en la calidad de vida de los residentes.

b. El *Forest Service* puede desarrollar y presentar propuestas con el propósito de obtener asignación de fondos por compensación y/o establecer bancos de mitigación debido a los impactos asociados de proyectos de desarrollos en la región. El objetivo será destinar estos recursos financieros para la adquisición de terrenos y/o la implantación de medidas de mitigación o regeneración de la flora o hábitats de los terrenos colindantes y/o sumergidos a lo largo de los ríos y tributarios de interés en la región. Para esto, deberán consultar con el Cuerpo de Ingenieros de los Estados Unidos y el Departamento de Recursos Naturales y Ambientales con el propósito de establecer política pública y acuerdos e identificar las áreas de objeto de interés.

III. En el Plan de Manejo, las áreas identificadas para uso recreacional en específico para el disfrute de bañistas, se deberá considerar vigorosamente la implantación de sistemas de seguridad y/o monitoreo, tales como: alarmas, sirenas y avisos de advertencias para la prevención de incidentes o accidentes producto de crecidas o golpes de agua.

IV. Recomendamos se comuniquen con la Comisión Federal Reguladora de Energía (en inglés, U.S.NRC) con el propósito obtener recomendaciones y/o endoso al proyecto.

V. La AEE opera la instalación de la Central Hidroeléctrica de Río Blanco, localizado en el Municipio de Naguabo. Un segmento considerable de nuestra infraestructura se encuentra dentro de los terrenos de la reserva forestal "El Yunque". En el pasado, los visitantes del área del Río Sabana frecuentemente irrumpían dentro de nuestra área de operación. En el año 2010, el Municipio de Naguabo construyó un área recreacional conocido como: *Sabana Picnic Area*. Este colinda con el área de entrada de acceso al proyecto hidroeléctrico de Río Blanco.

Esta acción incrementó el número de individuos que entraban en nuestra área de operación, por lo que hubo que implantar medidas de seguridad adicionales para evitar la posibilidad acceso. El propósito de la implantación de las medidas fue mitigar la práctica de disponer los desperdicios domésticos en las veredas y la prevención contra incidentes o accidentes en el área del proyecto. Por tal razón, se construyó un portón de control de acceso cuyas llaves han estado disponibles para las inspecciones del personal del Servicio Forestal de los Estados Unidos. Además, se instaló letreros de advertencia aviso de "prohibo la entrada" sin embargo los visitantes buscan la forma de entrar al proyecto.

La AEE hace constancia del problema de seguridad y limpieza que pueda surgir en las áreas recreacionales propuestas; en especial aquellas que puedan estar próximas a zonas sensitivas del sistema de bosques. Además, existe una alta posibilidad que se desplieguen actividades delictivas en el área y detrimento de los ecosistemas. La acción propuesta necesitará establecer en las áreas recreacionales un plan agresivo que posiblemente requerirá el reclutamiento de personal para realizar una función fiscalizadora continua y efectiva en las áreas.

VI. De acuerdo con las Reglas 115. D.2 y 115. D.3 del Reglamento de Evaluación y Trámite de Documentos Ambientales, la parte proponente para los casos futuros de proyectos de recreación o actividades económicas compatibles en el área deberá discutir el impacto ambiental para cada infraestructura propuesta y determinar la disponibilidad de la misma antes de la presentación de un documento ambiental. A eso efectos, deberá incorporar en el Documento Ambiental correspondiente las recomendaciones de la evaluación eléctrica realizada por la AEE que se obtiene mediante la Solicitud de Recomendación de Infraestructura (SRI) de la Oficina de Gerencia de Permisos. Le recordamos que la evolución eléctrica caduca al año de realizada. De no comenzar los trabajos en ese periodo, se deberá solicitar una nueva evaluación eléctrica.

VII. Con respecto al sistema eléctrico, dentro del área demarcada para el proyecto (**Ver Anejo 1, Fotografía Aérea de Infraestructura de Líneas Eléctricas de Distribución**), existen las siguientes líneas de distribución. Estas se describen a continuación:

Áreas y Municipios	Nomenclatura
Área Norte (Municipio de Río Grande)	4.80/8.22 KV circuito números (2301-02) 7.62/13.20 KV circuito número (2306-02)
Área Oeste (Municipio de Río Grande)	4.80/8.32 KV circuito número (2301-02)
Área Suroeste (Municipio de Canóvanas)	2.40/4.16 KV circuito número (2803-03)
Área Central (Municipios de Río Grande y Naguabo)	4.80/8.32 KV circuito número (2702-01)

VIII. La AEE posee infraestructura eléctrica de distribución dentro de lo que se considera el "*Yunque National Forest*", y si bien es cierto que la misma puede no guardar armonía con el plan de manejo ésta suple las necesidades básicas de las comunidades aledañas y a los concesionarios del Servicio Forestal. Es importante y necesario respetar los derechos de accesos y servidumbre de paso que la AEE posee, a los fines de reconstruir o dar mantenimiento para garantizar el funcionamiento y confiabilidad del sistema, esto con las debidas coordinaciones con el *U.S. Forest Service*. Por igual, se requiere de actividades de patrullaje de líneas mediante uso de helicópteros.

IX. Nuestro Programa de Mejoras Capitales (PMC) requiere que se provea capacidad generatriz adicional al sistema eléctrico y las extensiones necesarias a las líneas de transmisión y distribución del sistema. La Autoridad revisa y aprueba anualmente el PMC. El mismo está sujeto a cambios de acuerdo con las necesidades del sistema eléctrico y la capacidad financiera. La AEE se encuentra en proceso de evaluación de propuesta para la construcción de un nuevo alimentador de distribución soterrado a lo largo de la PR- 191, con una distancia por aproximada de 1.6 millas.

El proyecto Soterrado "El Yunque"- Propuesta para pareo de fondos FEMA

Este proyecto incluye proveer, construir, probar y poner en servicio un alimentador de 13.2KV, 4/0 AWG cobre, de forma soterrada. Este nuevo alimentador sustituirá 1.6 millas, desde el km 3.8 al km 6.4, del cable soterrado

monofásico existente con una nueva línea trifásica en la PR 191, Río Grande. El proyecto incluirá la obra civil de trincheras y registros desde el km 6.4 al km 12.8, más el remplazo de la infraestructura aérea en el *Trail Sector* en el área de las Antena y de las Comunicaciones. Los métodos de construcción serán trinchera abierta y perforación direccional horizontal. Las trincheras serán de 2 conductos de 4 pulgadas a lo largo de la ruta más 50 registros. Las dimensiones de las trincheras serán de 5 pies de profundidad y 18 pulgadas de ancho a lo largo de la ruta para cumplir con las especificaciones de la AEE.

Las instalaciones de telecomunicaciones de "El Yunque Peak" se alimentan eléctricamente de un alimentador de distribución remota que viene a través de las montañas y la densa vegetación. Este alimentador tiene una tasa muy alta de interrupción. La distancia desde el centro de despacho al sitio de carga es muy remota. Además, el camino está cubierto de vegetación por lo que es difícil de restaurar el servicio de una manera eficiente. Este proyecto es para construir un alimentador soterrado a partir de la entrada del Parque Nacional El Yunque y terminar justo donde comienza el *Monte Britton Trail* (donde se encuentran las instalaciones de telecomunicaciones) y restaurar el alimentador aéreo de allí al tope del *Sector Trail*. Este proyecto reemplazará el alimentador procedente del Municipio de Naguabo por un alimentador soterrado de Río Grande, que está mucho más cerca de las cargas. El tramo soterrado también eliminará el mantenimiento al alimentador existente debido a la vegetación.

Para información adicional, puede comunicarse con la Sra. Ruth Dones, Supervisora de Cumplimiento de Reglamentación Ambiental, por el (787) 521-4969 o 4968.

Cordialmente,

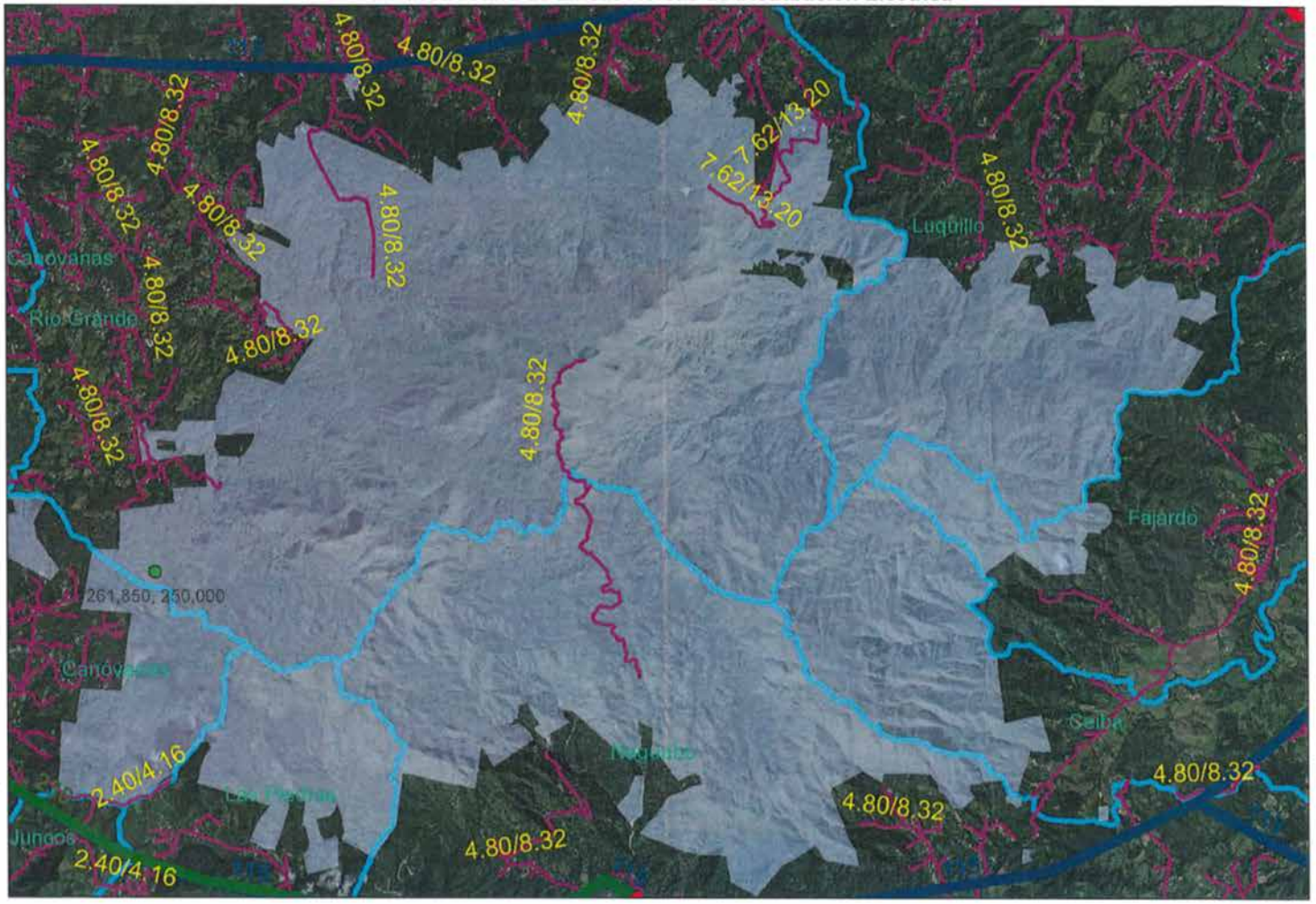
Indira Mohip Colón, Gerente
Departamento de Proyectos y
Licenciamiento Ambiental

Anejo 1

Fotografía Aérea

Infraestructura de Líneas Eléctricas de Distribución

Autoridad de Energía Eléctrica
Fotografía Aérea (Escala: 1:75,000)
Límite del Bosque Nacional El Yunque
Infraestructura de Lineas Aéreas de Distribución Eléctrica



COMMONWEALTH OF
PUERTO RICO
DDEC • Puerto Rico Tourism Company

November 9, 2016

Ms. Sharon Wallace
Forest Supervisor
El Yunque National Forest
HC-01, Box 13490
Rio Grande, PR
00745-9625

El Yunque National Forest Revised Land and Resource Management Plan (Draft)
Environmental Impact Statement (Draft)

Dear Ms. Wallace:

The Puerto Rico Tourism Company (PRTC) is pleased to greet you. We have reviewed the above mentioned documents. As you know, El Yunque National Forest (EYNF) is one of Puerto Rico's main tourist attractions. As the public corporation tasked by the Puerto Rico Legislative Assembly to develop the island's tourism sector, the PRTC is very interested in the sustainable management of the Forest.

We are pleased that many of the short and long term projects and goals that have been discussed and sometimes jointly proposed by the PRTC and the US Forest Service (USFS) are included in the Plan. Some of these goals are: improving access to the Forest, providing new recreational opportunities away from the PR-191 Corridor, and thinking about EYNF as an economic driver for Puerto Rico's eastern region.

We understand that the new co-management paradigm proposed by the revised Plan will benefit not only the natural environment but the livelihoods of those that rely on EYNF to meet their social and economic needs. The PRTC looks forward to working together with local communities, local entrepreneurs, and the USFS to develop sustainable tourism operations in the areas identified as Community Interface Resource Management Area (CIRMA) by the Plan.

PO Box 9023960, San Juan, PR 00902-3960
Tel: 787-721-2400 ext. 0000 / Fax:

PUERTO RICO TOURISM COMPANY

As for the draft Environmental Impact Statement, the PRTC concurs with USFS' determination that the selected course of action is the most desirable (Alternative 2). The selected alternative allows for the protection of the forest's ecosystem while allowing for the sustainable and responsible delivery of social and economic benefits for EYNF surrounding communities.

We appreciate USFS efforts in the sustainable stewardship of the natural wonder that is EYNF. We commend the staff at the EYNF for their efforts to engage not only local government agencies but the community at large in this novel planning process. Should you have any questions regarding our position, please contact me, or our planner William Pitre-Cipolla at 787 721-2400, extension 2063.

Cordially,

Edgardo M. Afanador-Garcia, M.Arch
Acting Director
Planning and Development Office

WPlmrd

ESTADO LIBRE ASOCIADO DE
PUERTO RICO
Oficina Estatal de Conservación Histórica
State Historic Preservation Office

November 3, 2016

Sharon Wallace
Forest Supervisor
El Yunque National Forest
HC01, Box 13490
Río Grande, PR 00745-9625

SHPO 08-14-08-01 DRAFT FOREST LAND AND RESOURCE MANAGEMENT PLAN and DRAFT ENVIRONMENTAL IMPACT STATEMENT, EL YUNQUE NATIONAL FOREST, RÍO GRANDE, PUERTO RICO / FILE CODE: 2360

Dear Ms. Wallace:

We have reviewed the *Draft Forest Land and Resource Management Plan* (Forest Plan) as well as the *Draft Environmental Impact Statement* published on the Federal Register to guide the general management direction of the El Yunque National Forest for the next fifteen years. We support the Cultural and Historic Resources goals and objectives listed in Section 3.3.7 of the Forest Plan to enhance the stewardship and protection of these resources. We also recommend that, under Cultural and Historic Resources standard S2, memoranda of agreements and letters documenting findings of effect be included as decision documents used to evidence compliance with Section 106 of the National Historic Preservation Act and its implementing regulation 36 CFR Part 800.

If you have any questions regarding this matter, please contact Miguel Bonini at (787) 721-3737 or mbonini@prshpo.pr.gov.

Sincerely,

Carlangeli Lech Moraza, Esq.
State Historic Preservation Officer

CLM/NPT/BRS/MB

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STATE HISTORIC PRESERVATION OFFICE
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OECH

Appendix B: Ecological Sustainability Evaluation and Species of Conservation Concern

Introduction

The 2012 Planning Rule (36 CFR 219) contains guidance providing for sustainability (CFR 219.8) and diversity of plants and animals (CFR 219.9). This guidance uses a complementary ecosystem and species-specific approach to maintaining the diversity of plant and animal communities and the persistence of native species in the plan area. Specifically, forest plans must contain components designed to maintain or restore the following elements:

- The diversity of ecosystems, including the following:
    a. Key characteristics associated with terrestrial and aquatic ecosystem types;
    b. Rare aquatic and terrestrial plant and animal communities; and
    c. The diversity of native tree species similar to that existing in the plan area.
- The ecological conditions to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area. Collectively these species groups are referred to as at-risk species, consistent with Forest Service planning direction (FSH 1909.12).

The ecological sustainability analysis process used in developing the revised forest plan also followed the direction in Forest Service Handbook 1909.12 Chapter 10 and Chapter 20. The process addressed at-risk species via ecosystem sustainability and integrity from species identification through to plan components. Using the coarse-filter/fine-filter approach, at-risk terrestrial and aquatic species, species groups, ecological systems and watersheds were carried through the preliminary assessment, assessment, planning frameworks (including strategies and plan alternatives), and expected outcomes phases, along with providing a basis for monitoring. Throughout this process, the best available scientific information and collaborative efforts were used to provide the basis and support for each step, including disclosing any data gaps and associated baseline inventory needs.

The planning area ecosystems and watersheds were identified, conditions assessed and departure ratings were provided using reference conditions and the natural range of variability, as well as taking into account the habitat requirements of associated biodiversity. Stresses and threats, including scope and severity, to these systems and species were identified. The at-risk species were identified and species were grouped as needed or when possible, considering group weights, and ecological needs and conditions. The Species Groups names were indicative of the ecological conditions needed for those species. The Species Groups were linked to their appropriate habitat (identified as Ecosystems or Watersheds), and linked to appropriate Key Characteristics and Indicators of their habitat which were then used to monitor the species. If species required specific needs outside of a species group, they were considered in the planning process as individual species (fine-filter). Criteria for sustainability were assigned to each Indicator and then Strategies were developed to work toward meeting sustainability. These Strategies are included in the forest plan components, and where applicable, plan alternatives. The Expected Outcome information is considered in time periods, 10 and 50 years out.

The ecological sustainability framework described below provides information to make strategic decisions in the forest planning framework. By restoring and maintaining the key characteristics, conditions, and functionality of native ecosystems, El Yunque National Forest should be able to not only improve ecosystem diversity, but also provide for the needs of diverse plant and animal species on El Yunque. Most plant and animal species needs are expected to be met by sustaining ecosystem diversity,

but species-specific analyses were conducted to evaluate whether additional provisions were needed for federally listed species, and species of conservation concern.

Public Involvement

There have been multiple opportunities provided for the public to provide input on the ecosystem and species diversity process used in the revision of El Yunque Forest Plan.

- At-risk species (March 6, 2014; May 8, 2014; and March 15, 2016)
- Preliminary need for change (October 30, 2014 through December 12, 2014)
- The new proposed plan alternatives (June 23, 2015 through June 25, 2015)

Opportunities for the Public to Submit Comments included:

45-day Scoping on the proposed action (September 19, 2014 through November 3, 2014).https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3820485.pdf. Information on the ecological sustainability and species of conservation concern used for scoping is contained in the following documents posted on the forest's website:

- El Yunque National Forest, Draft Forest Plan Assessment
- El Yunque Plan Revision: Proposed Management Strategies
- 90-day Comment Period on the Draft Forest Plan (September, 2016) and DEIS

To view all written public comments received during scoping and the 90-day comment on the draft forest plan, go to https://www.fs.usda.gov/project/?project=44662

Overview of Ecological Sustainability analysis

The need of a standardized regional approach for ecological and biological planning for the Forest planning process was the main reason to develop a collaborative initiative to create what is known as the ecological sustainability evaluation (ESE) tool. The ESE tool is a strategic conservation planning tool used by the USDA Forest Service Southern Region for forest planning. Ecological systems, watersheds, terrestrial and aquatic species are carried through the preliminary assessment, sustainability framework (including strategies and plan alternatives), and expected outcomes. The tool utilizes a standardized process while being flexible, efficient, and adaptable to Forest-specific priorities and needs. The ESE tool employs prioritization algorithms utilizing rank, importance rating, attributes and indicators, stresses and threats, scope and severity ratings, and management opportunities to assist and support management decisions while creating a standardized, credible, and defensible process record. The ESE tool analysis also considered the short term (1 to 10 years) and the long term (1 to 50 years) scenarios in the Forest.

The ecological sustainability evaluation (ESE) manual (see admin file), describes the analysis process used to identify, evaluate, and develop guidance for sustaining ecological diversity. This report and the ecological sustainability evaluation database from which it was derived not only provide the overall framework for many of the forest plan components and the systems-based direction in the revised forest plan, but also provide an important source of data and guidance for sustaining native ecological systems and species when implementing the forest plan.

The ecological sustainability framework is based on The Nature Conservancy Conservation Action Planning (CAP) process (TNC 2006) with changes in terminology to match Forest Service planning regulations. Using a coarse-filter/fine-filter approach, El Yunque National Forest identified ecosystems and associated at-risk species, key ecological characteristics for ecosystems, forest plan level indicators for evaluating their status, forest plan strategies, and resulting ecosystem sustainability ratings.

In regards to El Yunque, which is the only tropical rainforest in the National Forest System of the USDA Forest Service, the forest was presented with a dilemma due to its unique location and natural resources. El Yunque's vegetation specialist developed the type of ecosystem (forest types) and the Forest Biologist worked with other local wildlife specialists to provide a list of possible species of conservation concern that would meet the criteria that NatureServe uses for species selection.

El Yunque National Forest received assistance and technical advice from the regional office. The process included training for the vegetation and wildlife specialists to discuss the necessary information and process to integrate the data in the ESE tool format. The information was collected, identified, and integrated in the ESE tool by the Forest and wildlife program managers with the support of the regional office contractor and personnel.

The following steps were used to build an ecological sustainability framework, with each step documented within the ESE tool. This iterative process was methodical and utilized sequential steps, as described below.

1. Identify and define ecosystems

To define terrestrial ecological sustainability, all terrestrial ecosystems on El Yunque National Forest were identified using a modified PRGAP 2000 land cover map (Gould et al. 2007). This version includes several modifications, such as integrating the Holdridge ecological life zones (Ewel and Whitmore 1973), a 1969-feet elevation line (USGS), which determines cloud formation in the Forest and where the Cloud Forest community begins (Harris et al. 2012), a 130-inch precipitation line (Daly et al. 2003) and a 100-foot buffer around the rivers (National Hydrography Dataset) inside El Yunque to identify riparian forests. Our current vegetation classification map follows the hierarchy of the National Vegetation Classification down to "groups." Current area of each ecosystem was calculated based on associated ecological classification units using Forest Service geographic information system (GIS) data.

2. Identify species

To assess species diversity, an initial comprehensive list of at-risk plant and animal species was compiled by combining species lists from a variety of sources, including: federally-listed threatened and endangered species including proposed and candidate species obtained from the U.S. Fish and Wildlife Service, State species of concern obtained from the Puerto Rico's version of a Natural Heritage Program, the State Comprehensive Wildlife Conservation Strategy, and the Regional Forester's sensitive species. The list of potential species of conservation concern was included in the assessment. Additional species were added based on input from recognized conservation experts within the state. Species were then screened for inclusion in the framework and designated as threatened and endangered or species of conservation concern.

3. Identify and define key characteristics of ecosystem sustainability

To identify key characteristics for terrestrial and riparian ecosystems, subject matter experts reviewed lists and concepts of ecosystems and suggested important ecological characteristics and performance measures to be addressed during planning. Final determinations of ecological sustainability components were based on expert input, additional information from scientific literature and technical reports, and habitat needs of associated species. Performance measures were identified for both terrestrial and riparian systems. To produce a quantitative result, ratings were scored as integers 1 to 4 for each element, with multiple elements producing an overall score for the conservation measures being evaluated (Table B- 10).

Based on the indicator values, we calculated overall condition scores for each ecosystem group for each management alternative for 10 and 50 years' time periods. These scores were calculated by multiplying indicator values (1 to 4) by indicator weights (1 to 4) then averaging.

4. Link species to the ecosystems and watersheds and identify any additional needs of species

El Yunque biological and botanical specialists linked terrestrial and aquatic species to ecosystems and watersheds in which they occur. It was determined that species' needs were best met when species were grouped before linking them to ecosystems and, in particular, when key characteristics of ecosystems are linked to a given species groups' needs. This linkage allowed us to assess how well the ecosystem and watershed frameworks covered needs of these species. Where ecological conditions for these species were not covered by the ecological sustainability framework, additional characteristics, performance measures, and rating criteria were added so these species would be covered. Therefore, all "at-risk" species have their needs covered by ecological sustainability framework, or by a combination of the ecological sustainability framework and other additional forest plan components.

5. Develop Forest Plan components

Forest plan components were developed to provide ecosystem sustainability and ecological conditions for identified species based on the ecological sustainability evaluation framework. In some cases, current requirements and processes outside of the planning process were identified that address this goal. All elements of the ecological sustainability framework will be addressed by appropriate management direction in the forest plan.

6. Evaluate Ecological Sustainability Ratings to assess future outcomes at both 10- and 50-year time intervals.

To assess ecological sustainability we calculated a composite condition score for each ecosystem from all key characteristics. Rankings for all indicators were defined, weighted for each ecosystem based on expected outcomes under the three alternatives over 10- to 50-year time periods. Predictions were based on estimated acreage in coarse filter maintenance and with management trends in activities at 10- and 50-year intervals. Ecological composite scores were developed by multiplying indicator values by indicator weights then averaging. We then calculated overall scores for each ecosystem group and alternative combination. In general, declining overall scores over time indicate that alternatives may not adequately protect ecosystem sustainability and the diversity of associated species.

At-risk Species

A process parallel to the development of an ecosystem framework was the consideration of species, most of them "at risk," from extirpation in the foreseeable future, their distribution and habitat on El Yunque National Forest, drivers, threats, and ecological needs. Based on the final directives, the list of "at-risk" species for El Yunque includes:

- Federally -listed threatened, endangered, proposed and candidate species; and
- Species of conservation concern. Species of conservation concern are those plant and animal species whose long-term persistence within the plan area is of known conservation concern.

Species of Conservation Concern

The 2012 National Forest Planning Rule requires that species of conservation concern be "known to occur in the plan area" and that the Regional Forester identify the species of conservation concern for which

"the best available scientific information indicates substantial concern about the species' capability to persist over the long term in the plan area." During the assessment phase of forest plan revision, a team consisting of a botanist/ecologist, and wildlife biologist developed a comprehensive list of plant, wildlife, and aquatic species with the potential to occur on El Yunque National Forest. This list was based on a variety of sources, including: federally-listed threatened and endangered species occurring in the municipalities in northeastern Puerto Rico, obtained from the U.S. Fish and Wildlife Service, State species of conservation concern obtained from the Puerto Rico Department of Natural & Environmental Resources, which included species in the State Comprehensive Wildlife Conservation Strategy, and the Forest Service's list of sensitive species. El Yunque met with Edwin Muñiz and his staff of the Boquerón Office, U.S. Fish and Wildlife Service in January, 2015, to review the most updated process of reaching the finalized list of threatened and endangered species that would be addressed through preliminary forest plan direction.

Hurricane María and Hurricane Irma

The hurricanes in 2017 occurred after the ecological sustainability evaluation (ESE) tool analysis was completed. Hurricanes in general are a natural stressor included in the analysis. The effects of the disturbance, which include, vegetation defoliation, vegetation mortality, landslides, flooding, and other hurricane related changes in general are within the natural range of variability of ecosystems in the analysis. As stated in the Vegetation affected environment section, the hurricanes did not change the vegetation community types but rather it may have changed the successional state of plant communities and temporarily, their structure. The vast majority of the forest was severly defoliated and many trees lost their branches, thus temporarily altering the forest structure.

Since the effects from Hurricanes Irma and Maria did change the successional and structural states of many of the vegetation communities, the question was then raised as to whether or not the ESE tool analyses needed to be updated. It was decided that since this affected all the alternatives equally, the ESE tool analysis describing the relative differences between the alternatives was still valid. In addition, while the hurricanes have affected the current situation of the vegetation communities, these are short-term impacts. Over the long-term, the vegetation communities will recover and will still be able to contribute to the ecological needs of the Forest's at-risk species as analyzed in the ESE tool model.

Flora

To select the flora species for the ecological sustainability evaluation tool assessment, the current list of species reported for the Forest was the first source of information. To revise and enhance the list, a detailed review of the current and actual botanical literature was done to review and include any species reported for El Yunque. A total of 636 species of flora were included in the assessment and were appraised according to the criteria applied in the evaluation. Bibliographical and web-based botanical references were used to consider distribution, stress and threats, environmental concerns and other indications for the species.

After these species were considered, a sub-set group of species of conservation concern were identified and confirmed by botanical experts and a current literature review. These species of conservation concern were used to inform and identify plan components and for the final EIS to consider the impacts of the different Forest Plan alternatives.

Fauna

The wildlife selection process was unique due to the fact that from the approximate 182 fauna species that were initially assessed, many are not included in either NatureServe or their Latin American affiliate,

InfoNatura. These two data warehouses are the accepted source of the most up-to-date information on species occurrence and status.

The selection process for El Yunque National Forest answered two questions in identifying those species that were not included in the standard NatureServe provided data. First, what is the description of the methodology used to assign ranking to evaluate species; and second, how was the process conducted on those species that did not get identified as species of conservation concern, but were part of the initial list of evaluated species.

The rationale to assigning conservation status ranking was similar to the NatureServe's framework and core methodology. El Yunque biologists mimicked the Global, National, and State-ranks with the collected information by focusing on extinction risk on the global scale, and their extirpation risk at national and subnational levels. All species were considered in the design of ecological conditions within the plan area.

Much of the information found in the International Union of Conservation of Nature (IUCN) and the State Natural Heritage Plan (Puerto Rico wildlife conservation strategy) are interpreted to fulfill these ranks. Adhering to the same NatureServe factors such as range extent, area of occupancy, population size, and number of occurrences the biologists cumulated with a working ranking system. As a caveat, many species did not have all of these factors documented, but many other biologists on the Island acknowledge these data gaps.

The biologist then used the selected species to be incorporated into the prioritization elements found in both the preliminary assessment and sustainability planning framework of the ecological sustainability evaluation tool by inputting values into the tool's matrix. The matrix contains the following planning elements: conservation target, status, condition, stresses and threats, and priority. This populated ecological sustainability evaluation tool can then be used as a management monitoring tool for the Forest wildlife and fisheries program manager.

The list of species of conservation concern is located in the sections dealing with the species of conservation concern within the EIS document (see Chapter 3, Sections 3.4.3.3 and 3.4.3.6).

Watersheds

Information from the watershed condition framework (WCF) and El Yunque Watershed Condition Classification Supplemental Guidance (2010) completed for El Yunque National Forest were the main source of information for the ecological sustainability evaluation tool assessment. The 2014 Forest Plan Assessment, completed as part of the Forest Plan revision, also provided updated information for the watershed conditions within and outside the Forest boundaries.

The parameters in the watershed condition framework are presented in the following table. These parameters were considered and analyzed for the Plan alternatives considering short (1 to 10 years) and long (1 to 50 years) scenarios in the Blanco, Canovanas, Espiritu Santo, Fajardo, Mameyes, Pitahaya, Sabana and Santiago watersheds.

The ecological sustainability evaluation tool reports include a planning area score based on current conditions and a rating for a 10 and 50 years scenario by alternative considered in the Plan. The ecological sustainability evaluation tool also produces graphic representation by sustainability rating, plan alternatives, and the 10- and 50-year scenarios.

Table B- 1. Measurement criteria for watershed attributes

Key Attribute Name	What measure
Hydrologic Function	Flow Characteristics
Water Quality Sediments	Forest Coverage Rating
Water Quality Sediments	Riparian Road Density
Water Quality Sediments	Road Density Rating
Water Quality Sediments	Road Maintenance Index
Water Quality Toxics	Impaired Water Listed as 303D
Water Quality Toxics	Water Quality Problem (Not 303D listed)

Ecological Conditions for At-risk Species

The new vegetation classification for El Yunque resulted in 15 different forest types; however, the link between at-risk species and associated ecosystems was done with 5 forest types. Ecosystems were grouped according to similarities in forest types, e.g. under the ecosystem mature Tabonuco we grouped mature Tabonuco montane rain forest and mature Tabonuco montane wet forest, for secondary forest we grouped secondary montane wet, secondary montane wet cloud and secondary submontane moist forest, for mature Palo Colorado, we grouped mature Palo Colorado rain and mature Palo Colorado wet cloud forests, for mature Sierra Palm we grouped mature Sierra Palm montane wet, mature Sierra Palm montane wet cloud and mature Sierra Palm montane rain cloud forests and under mature *Tabebuia/Eugenia* we grouped mature Tabebuia/Eugenia montane rain cloud and mature Tabebuia/Eugenia montane wet cloud forests. These groupings were made due to the lack of specific and accurate plant distribution information available. No at-risk plant species were associated with riparian forests. The ecosystem acres presented is the sum of each forest type under its grouping.

Table B- 2. At-risk species groups and associated ecosystems, El Yunque National Forest

Species Group	Ecosystems	Ecosystem Acres
Mature Palo Colorado Montane Cloud Forest	Mature Palo Colorado Montane Forest	7,726
Mature Sierra Palm Montane Forest	Mature Sierra Palm Montane Forest	4,673
Mature *Tabebuia/Eugenia* Cloud Forest	Mature *Tabebuia/Eugenia* Cloud Forest	640
Mature Tabonuco Montane Forest	Mature Tabonuco Montane Forest	6,090
Secondary Forest	Secondary Forest	7,074

Table B- 3. At-risk species, mature *Tabebuia/Eugenia* woodland associate

Taxonomic Group	Scientific name	Common name
Bird	*Setophaga angelae*	Elfin woods warbler
Bird	*Falco peregrinus*	Peregrine falcon
Amphibian	*Eleutherodactylus eneidae*	Eneida's Coqui
Amphibian	*Eleutherodactylus gryllus*	Cricket Coqui
Amphibian	*Eleutherodactylus portoricensis*	Upland Coqui
Amphibian	*Eleutherodactylus unicolor*	Dwarf Coqui
Mollusk	*Luquilia luquillensis*	Luquillo mountain snail
Vascular Plants	*Ardisia luquillensis*	Bádula, mameyuelo

Taxonomic Group	Scientific name	Common name
Vascular Plants	*Banara portoricensis*	Caracolilo, Palo de Ramón, Tostado
Vascular Plants	*Brachionidium ciliolatum*	
Vascular Plants	*Brachionidium parvum*	
Vascular Plants	*Brunfelsia lactea*	Jazmín de monte, Aguacero, Vega Blanca
Vascular Plants	*Calyptranthes woodburyi*	
Vascular Plants	*Conostegia hotteana*	Camasey peludo
Vascular Plants	*Cybianthus sintenisii*	
Vascular Plants	*Eugenia egersii*	Palo de murta
Vascular Plants	*Gonocalix portoricensis*	
Vascular Plants	*Lepanthes caritensis*	Carite babyfoot orchid
Vascular Plants	*Lepanthes dodiana*	Dodiana babyfoot orchid
Vascular Plants	*Lepanthes stimsonii*	Stimson babyfoot orchid
Vascular Plants	*Lepanthes veleziana*	Velez babyfoot orchid
Vascular Plants	*Lepanthes woodburyana*	Woodbury babyfoot orchid
Vascular Plants	*Marlierea sintenisii*	Beruquillo
Vascular Plants	*Maytenus elongata*	Cuero de Sapo
Vascular Plants	*Miconia foveolata*	Camasey
Vascular Plants	*Miconia pycnoneura*	Camasey
Vascular Plants	*Mikania pachyphyla*	
Vascular Plants	*Morella holdrigeana*	Palo de Cera
Vascular Plants	*Pilea multicaulis*	
Vascular Plants	*Pilea yunquensis*	
Vascular Plants	*Psidium sintenisii*	Hoja Menuda
Vascular Plants	*Symplocos lanata*	Nispero cimarrón
Vascular Plants	*Ternstroemia heptasepala*	
Vascular Plants	*Urera chorocalpa*	Ortiga
Vascular Plants	*Varronia wagnerorum*	
Vascular Plants	*Eugenia haematocarpa*	Uvillo
Vascular Plants	*Ilex sintenisii*	Guayabota pequeña
Vascular Plants	*Ternstroemia luquillensis*	Palo Colorado
Vascular Plants	*Ternstroemia subsessilis*	

Table B- 4. At-risk species, secondary forest associates

Taxonomic Group	Scientific name	Common name
Mammal	*Stenoderma rufum*	Red –fig eating bat
Bird	*Buteo platypterus brunnescens*	Puerto Rican broad-winged hawk
Bird	*Accipter striatus venator*	Puerto Rican sharp-shinned hawk

Taxonomic Group	Scientific name	Common name
Reptile	*Epicrates inornatus*	Puerto Rican boa
Vascular Plants	*Brachionidium parvum*	
Vascular Plants	*Brunfelsia portoricensis*	Jazmin Portoricensis
Vascular Plants	*Callicarpa ampla*	Capá Rosa
Vascular Plants	*Calyptranthes woodburyi*	
Vascular Plants	*Coccoloba rugosa*	Ortegón
Vascular Plants	*Conostegia hotteana*	Camasey Peludo
Vascular Plants	*Cybianthus sintenisii*	
Vascular Plants	*Eugenia egersii*	Palo de Murta
Vascular Plants	*Laplacea portoricensis*	Maricao Verde
Vascular Plants	*Lepanthes dodiana*	Dodiana babyfoot orchid
Vascular Plants	*Lepanthes woodburyana*	Woodbury babyfoot orchid
Vascular Plants	*Magnolia splendens*	Laurel Sabino
Vascular Plants	*Maytenus elongata*	Cuero de Sapo
Vascular Plants	*Morella holdrigeana*	Palo de Cera
Vascular Plants	*Pleodendron macranthum*	Chupacallos
Vascular Plants	*Ravenia urbanii*	Tortugo Prieto
Vascular Plants	*Styrax portoricensis*	Palo de Jazmín
Vascular Plants	*Ternstroemia stahlii*	Palo de Buey
Vascular Plants	*Xylosma schwaneckeana*	Palo de Candela

Table B- 5. At-risk species, Palo Colorado associates

Taxonomic Group	Scientific name	Common name
Bird	*Accipter striatus venator*	Puerto Rican sharp-shinned hawk
Bird	*Amazona vittata*	Puerto Rican parrot
Bird	*Buteo platypterus brunnescens*	Puerto Rican broad-winged hawk
Bird	*Setophaga angelae*	Elfin woods warbler
Amphibian	*Eleutherodactylus richmondi*	Richmond's coqui
Amphibian	*Eleutherodactylus unicolor*	Dwarf Coqui
Amphibian	*Eleutherodactylus hedricki*	Tree-hole coqui
Amphibian	*Eleutherodactylus locustus*	Locust coqui
Amphibian	*Eleutherodactylus eneidae*	Eneida's Coqui
Amphibian	*Eleutherodactylus gryllus*	Cricket Coqui
Amphibian	*Eleutherodactylus karlschmidti*	Web-footed Coqui
Amphibian	*Eleutherodactylus wightmanae*	Melodious Coqui
Reptile	*Anolis cuvieri*	Puerto Rican giant anole
Reptile	*Anolis occultus*	Dwarf anole

Taxonomic Group	Scientific name	Common name
Vascular Plants	*Ardisia luquillensis*	Bádula, mameyuelo
Vascular Plants	*Banara portoricensis*	Caracolillo
Vascular Plants	*Brachionidium parvum*	
Vascular Plants	*Brunfelsia lactea*	Jazmín de monte
Vascular Plants	*Brunfelsia portoricensis*	
Vascular Plants	*Calyptranthes luquillensis*	
Vascular Plants	*Calyptranthes woodburyi*	
Vascular Plants	*Conostegia hotteana*	Camasey Peludo
Vascular Plants	*Cybianthus sintenisii*	
Vascular Plants	*Eugenia egersii*	Palo de Murta
Vascular Plants	*Gonocalix portoricensis*	
Vascular Plants	*Laplacea portoricensis*	Maricao Verde
Vascular Plants	*Lepanthes caritensis*	Carite babyfoot orchid
Vascular Plants	*Lepanthes dodiana*	Dodiana babyfoot orchid
Vascular Plants	*Lepanthes eltoroensis*	
Vascular Plants	*Lepanthes stimsonii*	Stimson babyfoot orchid
Vascular Plants	*Lepanthes veleziana*	Velez babyfoot orchid
Vascular Plants	*Lepanthes woodburyana*	Woodbury babyfoot orchid
Vascular Plants	*Lindsaea stricta var. jamesoniformis*	
Vascular Plants	*Magnolia splendens*	Laurel Sabino
Vascular Plants	*Marlierea sintenisii*	Beruquillo
Vascular Plants	*Maytenus elongata*	Cuero de Sapo
Vascular Plants	*Miconia foveolata*	Camasey
Vascular Plants	*Mikania pachyphyla*	
Vascular Plants	*Morella holdrigeana*	Palo de cera
Vascular Plants	*Pilea multicaulis*	
Vascular Plants	*Psidium sintenisii*	Hoja Menuda
Vascular Plants	*Ravenia urbanii*	Tortugo Prieto
Vascular Plants	*Solanum woodbury*	
Vascular Plants	*Ternstroemia heptasepala*	
Vascular Plants	*Ternstroemia luquillensis*	Palo Colorado
Vascular Plants	*Ternstroemia subsessilis*	
Vascular Plants	*Urera chorocalpa*	Ortiga
Vascular Plants	*Varronia wagnerorum*	
Vascular Plants	*Xylosma schwaneckeana*	Palo de Candela

Table B- 6. At-risk species, Sierra palm associates

Taxonomic Group	Scientific name	Common name
Amphibian	*Eleutherodactylus locustus*	Locust coqui
Bird	*Buteo platypterus brunnescens*	Puerto Rican broad-winged hawk
Bird	*Accipter striatus venator*	Puerto Rican sharp-shinned hawk
Vascular Plants	*Ardisia luquillensis*	Mamayuelo
Vascular Plants	*Banara portoricensis*	Caracolillo
Vascular Plants	*Brachionidium parvum*	
Vascular Plants	*Conostegia hotteana*	Camasey peludo
Vascular Plants	*Cybianthus sintenisii*	
Vascular Plants	*Eugenia egersii*	Palo de Murta
Vascular Plants	*Gonocalix portoricensis*	
Vascular Plants	*Laplacea portoricensis*	Maricao Verde
Vascular Plants	*Lepanthes caritensis*	Carite babyfoot orchid
Vascular Plants	*Lepanthes dodiana*	Dodiana babyfoot orchid
Vascular Plants	*Lepanthes stimsonii*	Stimson babyfoot orchid
Vascular Plants	*Lepanthes veleziana*	Velez babyfoot orchid
Vascular Plants	*Lepanthes woodburyana*	Woodbury babyfoot orchid
Vascular Plants	*Marlierea sintenisii*	Beruquillo
Vascular Plants	*Maytenus elongata*	Cuero de Sapo
Vascular Plants	*Mikania pachyphyla*	
Vascular Plants	*Morella holdrigeana*	Palo de Cera
Vascular Plants	*Pilea yunquensis*	
Vascular Plants	*Psidium sintenisii*	Hoja Menuda
Vascular Plants	*Symplocos lanata*	Nispero Cimarrón
Vascular Plants	*Ternstroemia heptasepala*	
Vascular Plants	*Ternstroemia subsessilis*	

Table B- 7. At-risk species, Tabonuco associates

Taxonomic Group	Scientific name	Common name
Mammal	*Stenoderma rufun*	Red –fig eating bat
Bird	*Buteo platypterus brunnescens*	Puerto Rican broad-winged hawk
Bird	*Accipter striatus venator*	Puerto Rican sharp-shinned hawk
Bird	*Icterus portoricensis*	Puerto Rican oriole
Reptile	*Epicrates inornatus*	Puerto Rican boa
Reptile	*Anolis cuvieri*	Puerto Rican giant anole
Reptile	*Anolis occultus*	Dwarf anole
Amphibian	*Eleutherodactylus locustus*	Locust coqui
Vascular Plants	*Callicarpa ampla*	Capá Rosa

Taxonomic Group	Scientific name	Common name
Vascular Plants	*Brunfelsia lactea*	Jazmín de Monte
Vascular Plants	*Calyptranthes woodburyi*	
Vascular Plants	*Coccoloba rugosa*	Ortegón
Vascular Plants	*Conostegia hotteana*	Camasey Peludo
Vascular Plants	*Cybianthus sintenisii*	
Vascular Plants	*Eugenia egersii*	Palo de Murta
Vascular Plants	*Eugenia haematocarpa*	Uvillo
Vascular Plants	*Laplacea portoricensis*	Maricao Verde
Vascular Plants	*Lepanthes dodiana*	Dodiana babyfoot orchid
Vascular Plants	*Lepanthes selenitepala spp ackermanii*	Ackerman babyfoot orchid
Vascular Plants	*Lepanthes veleziana*	Velez babyfoot orchid
Vascular Plants	*Lepanthes woodburyana*	Woodbury babyfoot orchid
Vascular Plants	*Magnolia splendens*	Laurel Sabino
Vascular Plants	*Maytenus elongata*	Cuero de Sapo
Vascular Plants	*Morella holdrigeana*	Palo de Cera
Vascular Plants	*Pleodendron macranthum*	Chupacallos
Vascular Plants	*Psidium sintenisii*	Hoja menuda
Vascular Plants	*Styrax portoricencis*	Palo de Jazmín
Vascular Plants	*Ternstroemia luquillensis*	Palo Colorado
Vascular Plants	*Ternstroemia stahlii*	Palo de Buey
Vascular Plants	*Xylosma schwaneckeana*	Palo de Candela

Table B- 8. At-risk species, riparian associates

Taxonomic Group	Scientific name	Common name
Aquatic Invertebrate	*Macrobrachium carcinus*	Bigclaw river shrimp
Aquatic Invertebrate	*Macrobrachium crenulatum*	Crenulated river shrimp
Fish (Eel)	*Anguilla rostrata*	American eel
Fish	*Awaous banana*	Yellow river goby
Fish	*Dormitator maculatus*	Fat sleeper
Fish	*Eleotris pisonis*	Spinycheek sleeper
Fish	*Gobiomorus dormitor*	Bigmouth sleeper

Overall Ecological Sustainability Ratings

Based on the indicator values presented in the tables below, we calculated overall condition scores for each ecosystem group for each alternative. These scores are the basis for assessing ecological sustainability under the alternatives. These scores were calculated by multiplying indicator values (1 to 4) by indicator weights (1 to 4) then averaging. Condition scores ranging from 1.00-1.50 indicates poor condition; element conditions are severely inadequate and species populations are expected to severly decline. Scores ranging from 1.51-2.50 indicate fair conditions; element conditions are slightly

inadequate, but species may persit for some time. Scores in the range of 2.51-3.50 are in good condition; element conditions are acceptable; species' populations should remain stable. Scores that range from 3.51-4.00 are in very good condition; element conditions are optimal and species' populations should remain robust and potentially even expand. Table B- 9 summarizes these results.

Table B- 9. Overall ecological sustainability ratings

Ecosystem group	Alt 1 – 10 yr	Alt 1 – 50 yr	Alt 2 – 10 yr	Alt 2 – 50 yr	Alt 3 – 10 yr	Alt 3 – 50 yr
Mature Palo Colorado montane rain cloud forest	2.833333	2.550000	2.625000	2.550000	2.833333	2.625000
Mature Palo Colorado montane wet cloud forest	2.550000	2.550000	2.550000	2.550000	2.550000	2.550000
Mature Sierra Palm montane rain cloud forest	2.250000	2.400000	2.300000	2.300000	2.300000	2.300000
Mature Sierra Palm montane wet cloud forest	2.187500	2.187500	2.187500	2.187500	2.187500	2.187500
Mature Sierra Palm montane wet forest	2.312500	2.312500	2.312500	2.312500	2.312500	2.312500
Mature *Tabebuia/ Eugenia* Elfin woodland montane wet cloud forest	2.550000	2.550000	2.550000	2.291666	2.550000	2.500000
Mature Tabebuia/Eugenia Elfin woodland montane rain cloud forest	2.687500	2.687500	2.687500	2.687500	2.687500	2.687500
Mature Tabonuco montane rain forest	1.812500	1.812500	1.812500	1.812500	1.900000	1.812500
Mature Tabonuco montane wet forest	2.250000	2.150000	2.250000	1.687500	2.250000	2.150000
Riparian montane rain and wet cloud forest	2.312500	2.312500	2.312500	2.312500	2.312500	2.312500
Riparian montane rain and wet forest	2.312500	2.250000	2.833333	2.300000	2.833333	2.833333
Riparian submontane moist forest	2.312500	2.150000	2.312500	2.312500	2.312500	2.312500
Secondary montane wet cloud forest	2.250000	2.250000	2.250000	2.041666	2.250000	2.250000
Secondary montane wet forest	2.187500	1.950000	1.625000	1.500000	2.250000	1.666666
Secondary submontane moist forest	2.050000	2.083333	2.200000	2.050000	2.350000	2.375000

Forest Plan Components and Strategies

We evaluated plan area conditions needed for all species using a coarse-filter/fine-filter approach.

Desired conditions, objectives, and design criteria for maintaining and restoring ecosystem integrity provide coarse filter habitat provisions for all species. Fine-filter strategies for species were developed where needed to contribute to the recovery of threatened and endangered species, conserve proposed and candidate species, and maintain or restore ecological conditions for sustaining a viable population of each species of conservation concern where possible and ecologically feasible, given the capabilities of our land base. See Table B- 10 for a summary of forest plan components.

Table B- 10. At-risk species and associated ecological conditions, key characteristics, and forest plan components, El Yunque National Forest. Ecological conditions refer to the different forest types: Secondary-all plantation/secondary forest types, tabonuco-all tabonuco types, sierra palm-all Sierra palm forest types, palo colorado-all palo colorado forest types and Tabebuia/Eugenia-all Tabebuia/Eugenia forest types.

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Amazona vittata	Palo Colorado Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 7, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2, 3; 3.1.9 Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S1, S2, G1, G2,
Buteo platypterus brunnescens	Tabonuco, Sierra Palm, Palo Colorado and Secondary Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 7, 8, 11, 12, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S1, S2, G1
Accipiter striatus venator	Tabonuco, Sierra Palm, Palo Colorado and Secondary Forests types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 7, 8, 11, 12, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S1, S2, G1
Setophaga angelae	Palo Colorado and Tabebuia/Eugenia Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, , 7, 9, 13, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1, G2, G4
Epicratus inornatus	Tabonuco & Secondary Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S2, G1

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Eleutherodactylus brittoni	Sierra Palm, Palo Colorado Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 12, 13,14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries S1, S2, G1, G2
Eleutherodactylus eneidae	Palo Colorado and Tabebuia/Eugenia Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 13, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species Fauna: S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Eleutherodactylus gryllus	Palo Colorado and Tabebuia/Eugenia Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 13, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Eleutherodactylus hedricki	Tabonuco & Palo Colorado Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 6, 7, 11, 13,14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Eleutherodactylus karlschmidti	Palo Colorado Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Eleutherodactylus locustus	Palo Colorado and Sierra Palm Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 12, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Eleutherodactylus portoricensis	Tabebuia/Eugenia Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 9, 1314	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Eleutherodactylus richmondi	Palo Colorado and Tabebuia/Eugenia Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 12, 13, , 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Eleutherodactylus unicolor	Palo Colorado and Tabebuia/Eugenia Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 12, 13 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Eleutherodactylus wightmanae	Palo Colorado types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1-3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Anguilla rostrata	Riparian	Percentage of or amount of forest cover, riparian area tree and shrub distribution, aquatic biota composition,	3.1.4 Aquatic Ecosystem DC1, 2, 3, 5, 8	3.1.4 Aquatic Ecosystem MS1, 3	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC1	3.1.9 Wildlife & Fisheries: MS1, 3, 7	3.1.9 Fisheries and other aquatic species: S1, G1, G2
Awaous banana	Riparian	Percentage of or amount of forest cover, riparian area tree and shrub distribution, aquatic biota composition,	3.1.4 Aquatic Ecosystem DC1, 2, 3, 8	3.1.4 Aquatic Ecosystem MS1, 3	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC1	3.1.9 Wildlife & Fisheries: MS1, 3	3.1.9 Fisheries and other aquatic species: S1, G1, G2
Dormitator maculatus	Riparian	Percentage of or amount of forest cover, riparian area tree and shrub distribution, aquatic biota composition,	3.1.4 Aquatic Ecosystem DC1, 2, 3, 8	3.1.4 Aquatic Ecosystem MS1, 3	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC1	3.1.9 Wildlife & Fisheries: MS1, 3	3.1.9 Fisheries and other aquatic species: S1, G1, G2
Eleotris pisonis	Riparian	Percentage of or amount of forest cover, riparian area tree and shrub distribution, aquatic biota composition,	3.1.4 Aquatic Ecosystem DC1, 2, 3, 8	3.1.4 Aquatic Ecosystem MS1, 3	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC1	3.1.9 Wildlife & Fisheries: MS1, 3	3.1.9 Fisheries and other aquatic species: S1, G1, G2
Gobiomorus dormitor	Riparian	Percentage of or amount of forest cover, riparian area tree and shrub distribution, aquatic biota composition,	3.1.4 Aquatic Ecosystem DC1, 2, 3, 8	3.1.4 Aquatic Ecosystem MS1, 3	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC1	3.1.9 Wildlife & Fisheries: MS1, 3	3.1.9 Fisheries and other aquatic species: S1, G1, G2
Macrobrachium carcinus	Riparian	Percentage of or amount of forest cover, riparian area tree and shrub distribution, aquatic biota composition,	3.1.4 Aquatic Ecosystem DC1, 2, 3, 8	3.1.4 Aquatic Ecosystem MS1, 3	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC1	3.1.9 Wildlife & Fisheries: MS1, 3	3.1.9 Fisheries and other aquatic species: S1, G1, G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Macrobrachium crenulatum	Riparian	Percentage of or amount of forest cover, riparian area tree and shrub distribution, aquatic biota composition,	3.1.4 Aquatic Ecosystem DC1, 2, 3, 8	3.1.4 Aquatic Ecosystem MS1, 3	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC1	3.1.9 Wildlife & Fisheries: MS1, 3	3.1.9 Fisheries and other aquatic species: S1, G1, G2
Falco peregrinus	Tabebuia/Eugenia Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Icterus portoricensis	Tabonuco, Secondary Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S2, G1
Stenoderma rufum	Tabonuco,& Secondary Forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S2, G1
Luquillia luquillensis	Tabebuia/Eugenia Forest type	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Anolis cuvieri	Tabonuco, and Palo Colorado forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 6, 7, 10, 11,13, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Anolis occultus	Tabonuco, and Palo Colorado forest types	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 6, 7, 10, 11, 13, 14	3.1.2 Terrestrial Ecosystem O1	3.1.10 At Risk species: Fauna DC1, 2; Wildlife and Fisheries DC2	3.1.10 At Risk species Fauna O1, MS1, 3	3.1.10 At Risk species: Fauna S2, G1; Wildlife and Fisheries: S1, S2, G1, G2
Ardisia luquillensis	Secondary, Sierra Palm, Palo Colorado, Tabebuia/Eugenia	Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 11, 12, 13	3.1.2 Terrestrial Ecosystem O1 and MS 2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Banara portoricensis	Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Components of distribution, structure and composition of forest types Native species abundance, basal area, species density, and percent closed canopy	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora, G2
Brachionidium ciliolatum	Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 9, 13	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora S1, G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Brachionidium parvum	Secondary, Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 12, 13, 134	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora S1, G2
Brunfelsia lactea	Secondary, Tabonuco, Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 9, 10, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Brunfelsia portoricensis	Secondary, Palo Colorado	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 7, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Callicarpa ampla	Secondary, Tabonuco	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1, 2 and MS1, 2, 3	3.1.11 At-risk Species: Flora G1, 2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Calyptranthes luquillensis	Secondary, Palo Colorado	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 7, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Calyptranthes woodburyi	Secondary, Tabonuco, Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 9, 10, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Coccoloba rugosa	Secondary, Tabonuco	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Conostegia hotteana	Secondary, Tabonuco, Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Cybianthus sintenisii	Secondary, Tabonuco, Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Eugenia eggersii	Secondary, Tabonuco, Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2 5, 6, 7, 8, 9, 10, 11, 12, 13, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Eugenia haematocarpa	Secondary, Tabonuco	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3, 4	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1, 2 and MS1, 2, 3	3.1.11 At-risk Species: Flora G1, 2
Gonocalyx portoricensis	Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 9, 11, 12, 13	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Ilex sintenissii	Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 9, 13	3.1.2 Terrestrial Ecosystem O1 and MS2, 3, 4	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1, 2 and MS1, 2, 3	3.1.11 At-risk Species: Flora G1, 2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Laplacea portoricensis	Secondary, Tabonuco, Sierra Palm, Palo Colorado	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 10, 11, 13, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Lepanthes caritensis	Sierra Palm, Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 9, 11, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora S1, G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Lepanthes dodiana	Secondary, Tabonuco, Sierra Palm, Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora S1, G2
Lepanthes eltoroensis	Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1, 2 and MS1, 2, 3	3.1.11 At-risk Species: Flora S1, G1, 2
Lepanthes selenitepala spp. ackermanii	Tabonuco	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 6, 11	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora S1, G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Lepanthes stimsonii	Palo Colorado, Tabebuia/Eugenia, Sierra Palm	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora S1, G2
Lepanthes veleziana	Secondary, Tabonuco, Palo Colorado, Tabebuia/Eugenia, Sierra Palm	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora S1, G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Lepanthes woodburyana	Secondary, Tabonuco, Palo Colorado, Tabebuia/Eugenia, Sierra Palm	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora S1, G2
Lindsaea stricta var. jamesoniiformis	Palo Colorado	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Magnolia splendens	Secondary, Tabonuco, Palo Colorado	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 10, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Marlierea sintenisii	Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Maythenus elongata	Secondary, Tabonuco, Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS3, 2	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Miconia foveolata	Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Miconia pycnoneura	Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 9, 13	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Mikania pachyphylla	Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 9, 11, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Morella holdrigeana	Secondary, Tabonuco, Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Pilea multicaulis	Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Pilea yunquensis	Secondary, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 8, 9, 11, 12, 13, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Pleodendron macranthum	Secondary, Tabonuco	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1, 2 and MS1, 2, 3	3.1.11 At-risk Species: Flora G1, 2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Psidium sintenesii	Secondary, Tabonuco, Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Ravenia urbanii	Secondary	Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 5, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Solanum woodburyi	Palo Colorado	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 7, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Styrax portoricensis	Secondary, Tabonuco	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1, 2 and MS1, 2, 3	3.1.11 At-risk Species: Flora G1, 2
Symplocos lanata	Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 8, 9, 12, 13	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Ternstroemia heptasepala	Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 8, 9, 11, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Ternstroemia luquillensis	Secondary, Tabonuco,Palo Colorado	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 10, 14, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1, 2 and MS1, 2, 3	3.1.11 At-risk Species: Flora G1, 2
Ternstroemia stahlii	Secondary, Tabonuco	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types Species abundance, stem density, basal area and species density of secondary forests	3.1.2 Terrestrial Ecosystem DC1, 5, 6, 11, 16	3.1.2 Terrestrial Ecosystem O1 and MS2, 3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Ternstroemia subsessilis	Palo Colorado, Sierra Palm, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 7, 8, 9, 11, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1, 2 and MS1, 2, 3	3.1.11 At-risk Species: Flora G2
Urera chlorocarpa	Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2
Varronia wagnerorum	Palo Colorado, Tabebuia/Eugenia	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 7, 9, 12, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

			Coarse-filter		Fine-filter		
Scientific Name	**Ecological Conditions**	**Key Characteristics and Indicators**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Desired Conditions**	**Objectives & Mgmt. Strategies**	**Standards & Guidelines**
Xylosma schwaneckeana	Secondary, Tabonuco, Palo Colorado	Native species abundance, basal area, species density, and percent closed canopy Components of distribution, structure and composition of forest types	3.1.2 Terrestrial Ecosystem DC1, 2, 5, 6, 7, 10, 13, 14	3.1.2 Terrestrial Ecosystem O1 and MS3	3.1.11 At-risk Species: Flora DC1, 2	3.1.11 At-risk Species: Flora O1 and MS1, 2	3.1.11 At-risk Species: Flora G2

Appendix C: Wild and Scenic Rivers Eligibility and Study Process

Introduction

This appendix addresses the suitability and eligibility of rivers located in El Yunque National Forest for inclusion in the National Wild and Scenic River System. An eligibility study of the Forest's rivers was completed for the 1997 Forest Plan.

The Wild and Scenic Rivers Act

The National Wild and Scenic Rivers System was created by Congress in 1968 (public law 90-542; 16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Wild and Scenic Rivers Act protects the special character of these rivers, while also recognizing the potential for their appropriate use and development.

Selected rivers in the United States are preserved for possessing outstandingly remarkable values, which include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. Designated rivers, or rivers segments, are preserved in their free-flowing condition and are not dammed or otherwise impeded.

The process of determining whether a river should be recommended for inclusion into the National Wild and Scenic River System has three steps: an eligibility determination with assigned potential classification, a suitability determination, and recommendation to Congress. Any river deemed eligible may be studied for its suitability for inclusion in the national system at any time. Rivers may be studied for suitability as a part of land management plan development, revision, or amendment; in conjunction with a project decision, or in a separate study. A suitability study is done after an eligibility study is completed. A suitability study provides the basis for determining which eligible rivers or river segments should be recommended to Congress as potential additions to the national system. Suitability studies are analyzed and completed in an environmental impact statement; they may or may not be completed with revision of a land management plan.

When the Forest Service determines a river is eligible for inclusion in the national system, they must ensure the river has interim protection measures (Forest Service Handbook (FSH) 1909.12, chapter 80). These protection measures apply until a decision is made on the future use of the river and adjacent lands through an act of Congress, or until a determination is made that the river is not suitable.

Eligible wild and scenic rivers (or river segments) are assigned one or more potential classifications: wild, scenic, or recreational. These classifications are based on the developmental character of the river on the date of designation and dictate what level of interim protection measures to apply. Wild rivers are the most remote and undeveloped while recreational rivers often have many access points, roads, railroads, and bridges, and may have undergone some impoundment or diversion in the past. A river's classification is not necessarily related to the value that made it worthy of designation. That is, for a river to have a scenic classification, scenery does not have to be an outstandingly remarkable value.

When developing a plan or plan revision, the responsible official shall identify the eligibility of rivers for inclusion in the National Wild and Scenic Rivers System, unless a systematic inventory has been

previously completed and documented, and there are no changed circumstances that warrant additional review ((36 CFR sec. 219.7(c)(2)(vi))).

A systematic inventory of all potential study rivers was previously completed in the 1997 Forest Plan for the Caribbean National Forest/Luquillo Experimental Forest. Fifteen rivers/perennial streams, totaling over 52 miles, were studied (see FEIS for the 1997 Forest Plan, Appendix D, and Table D-1). The result of this analysis was that of the 15 rivers studied, 6 rivers were determined to be eligible for designation. These rivers were the Rio Espiritu Santo, Rio Mameyes, Rio de la Mina, Rio Fajardo, Rio Icacos, and Rio Sabana. This plan revision was limited to the evaluation of any rivers that were not previously evaluated for eligibility and those with changed circumstances. There are no changed circumstances and all potential rivers were evaluated; therefore, no additional review is warranted.

Utilizing the 1997 Plan EIS Wild and Scenic River Eligibility Summary, the Rio Mameyes, Rio de la Mina and Rio Icacos were selected as rivers to be recommended for designation as wild and scenic rivers. The Caribbean National Forest Wild and Scenic Rivers Act of 2002 designated these rivers as part of the National Wild and Scenic River System.

Table C- 1. Wild, scenic, and recreation rivers (designated December 2002)

River	Classifications	Length (miles)
Río Mameyes	Wild	1.6
	Scenic	1.4
	Recreation	1.0
Río de la Mina	Scenic	1.2
	Recreation	0.9
Río Icacos	Scenic	2.3

ID Team and Public Involvement

During this plan revision process, community outreach planning meetings were held. During these meetings the participants were informed of the designated wild and scenic rivers and that currently the Forest has three such rivers. The wild and scenic river designation process was explained during these meetings and during these meetings no community or participant indicated that recreational or other outstandingly remarkable values had changed from the previous study in the 1997 Forest Plan.

Inventoried Rivers

Appendix D of the 1997 Forest Plan contains a description of rivers. The 2014 Forest Plan Assessment and subsequent public involvement indicated no changed condition in regards to previously studied rivers. Table C- 2 summarizes the analysis.

Table C- 2. El Yunque National Forest rivers analyzed

Potential classification of Eligible Rivers The potential classification of a river is based on the condition of the river and the adjacent lands as they exist at the time of study. The Wild and Scenic River Act specifies the following three classifications categories for eligible rivers.	**Wild** Those rivers or sections of rivers that are free of impoundment and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive lands.	**Scenic** Those rivers or section of rivers that are free of impoundment, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.	**Recreation** Those rivers or section of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some important impoundment or diversion in the past.
Rio Espiritu Santo	From headwaters of Rio Espiritu Santo to water supply intake immediately upstream from FDR 12 road crossing, 2.94. From headwaters of both Quebrada Sonadora tributaries to 100 yards of Route 186, 1.98 miles.	From water supply intake on Rio Espiritu Santo near FDR12 to 100 yards south of Route 186, 0.78 miles.	On Rio Espiritu Santo from 100 yards south of Route 186, north to Forest boundary, 1.96. On Quebrada Sonadora, from 100 yards south of Route 186, north to Rio Espiritu Santo, 0.28 miles.
Rio Mameyes	From its headwaters in the Baño de Oro Natural Area to the crossing points of Trail #24 and Trail #11, just upstream from the confluence with Rio La Mina, 2.1 miles.	From the crossing point of Trail #24 and #11 to the access point of Trail #7, 1.4 miles.	From the access point of Trail #7 to the Forest boundary west of the bridge on PR 191, 1.0 miles.
Rio La Mina	The La Mina has no wild component.	From its confluence with the Rio Mameyes upstream to the La Mina Falls, 1.2 miles.	From La Mina Falls to its headwaters located east of PR 191 between Km. 12 and Km. 12 in El Yunque Zone, 0.9 miles.
Rio Fajardo	The total length of the river corridor from its headwaters approximately 0.5 mile north of West Peak to the Forest boundary approximately 1.5 miles east of Pico del Este, 3.4 miles.	The Rio Fajardo has no scenic components.	The Rio Fajardo has no recreational component.

Potential classification of Eligible Rivers The potential classification of a river is based on the condition of the river and the adjacent lands as they exist at the time of study. The Wild and Scenic River Act specifies the following three classifications categories for eligible rivers.	**Wild** Those rivers or sections of rivers that are free of impoundment and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive lands.	**Scenic** Those rivers or section of rivers that are free of impoundment, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.	**Recreation** Those rivers or section of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some important impoundment or diversion in the past.
Rio Icacos	The Rio Icacos has no wild component.	From its headwaters, approximately 0.5 mile south of the intersection of the Mt. Britton Road (#9938) with PR 191 to the point where the river leaves National Forest ownership (approximately 0.25 mile upstream of the PREPA hydroelectric dam), 2.3 miles.	The Rio Icacos has no recreational component.
Rio Sabana	From its headwaters, approximately 0.75 of a mile east of El Cacique Peak to 0.25 mile north of the PR 191 crossing near the southern Forest boundary, 1.8 miles.	The Rio Sabana has no scenic component	From approximately 0.25 mile north of the PR 191 crossing to the southern Forest boundary, 0.3 miles.

Eligible Rivers

Appendix D of the 1997 Forest Plan contains a description of eligible rivers and documentation of previous study process. The 2014 Forest Plan Assessment and subsequent public involvement indicated no changed condition in regard to previously studied rivers. The list of eligible rivers is:

- Rio Espiritu Santo/Quebrada Sonadora
- Rio Fajardo
- Rio Sabana

Suitability

Recommendations for wild and scenic river designation is part of the Forest Plan revision. The effects of designation are analyzed in chapter 3 of this document.

The identification of a river for study through the Forest planning process does not trigger any protection under the Act until designation by Congress. Importantly, identifying rivers as eligible, or eligible and suitable, does not create any new agency authority; rather, it focuses the management actions within the discretion of the Forest Service on protecting identified river values. For eligible rivers, the preliminary (inventoried) classification is to be maintained absent a suitability determination. The recommended classification is to be maintained throughout the duration of the Forest Plan. Protection of rivers and streams through the Forest planning process helps to assure high-quality, free-flowing rivers and streams, as well as river-related recreation opportunities.

Management emphasis for the eligible rivers and their corridors is focused on protection and enhancement of the values for which they were established, without limiting other uses that do not substantially interfere with public use and enjoyment of those values. The establishment values (ORVs) for the rivers on El Yunque National Forest include scenic, recreational, geological, fish and wildlife, historical, cultural or other values including ecological.

Most impacts to all rivers come from upland activities outside the river corridor. However, Forest management would be subordinate to the river's ORVs. Vegetation management, road construction and construction or removal of recreation facilities could cause erosion along the river, sedimentation from soil runoff, visual intrusions or noise from nearby activities

Search and rescue operations may cause some impact from the use of equipment in the river corridor, but these are predicted to be minimal. Increased public interest and use may result with the creation of CIRMA by having additional trailheads and trails and access points to the river to accommodate additional public interest and use of the river. However, increased recreation use due to designation may also result in more river-related activities and cause localized increases in soil compaction and erosion of stream banks and the need for limited public access.

River sections classified as "scenic" or "recreational" are managed with a wider variety of activities allowed within the river corridor. However, Forest management would be subordinate to the river's ORVs. Sights and sounds of man's activities would be more apparent. Management activities that have the greatest potential of affecting rivers and their potential suitability for wild and scenic designation are road construction, vegetation management, insect and disease control, special use utility right-of-ways and mineral extraction. Other management activities that also can affect the river resources to a degree are threatened and endangered species habitat management, range management, recreation and administrative site facilities. Classification as "wild" would therefore be expected to have a smaller range of effects from activities within the river corridor, (e.g., no new roads, no new rights-of-way or wildlife openings).

Non-eligible Rivers.

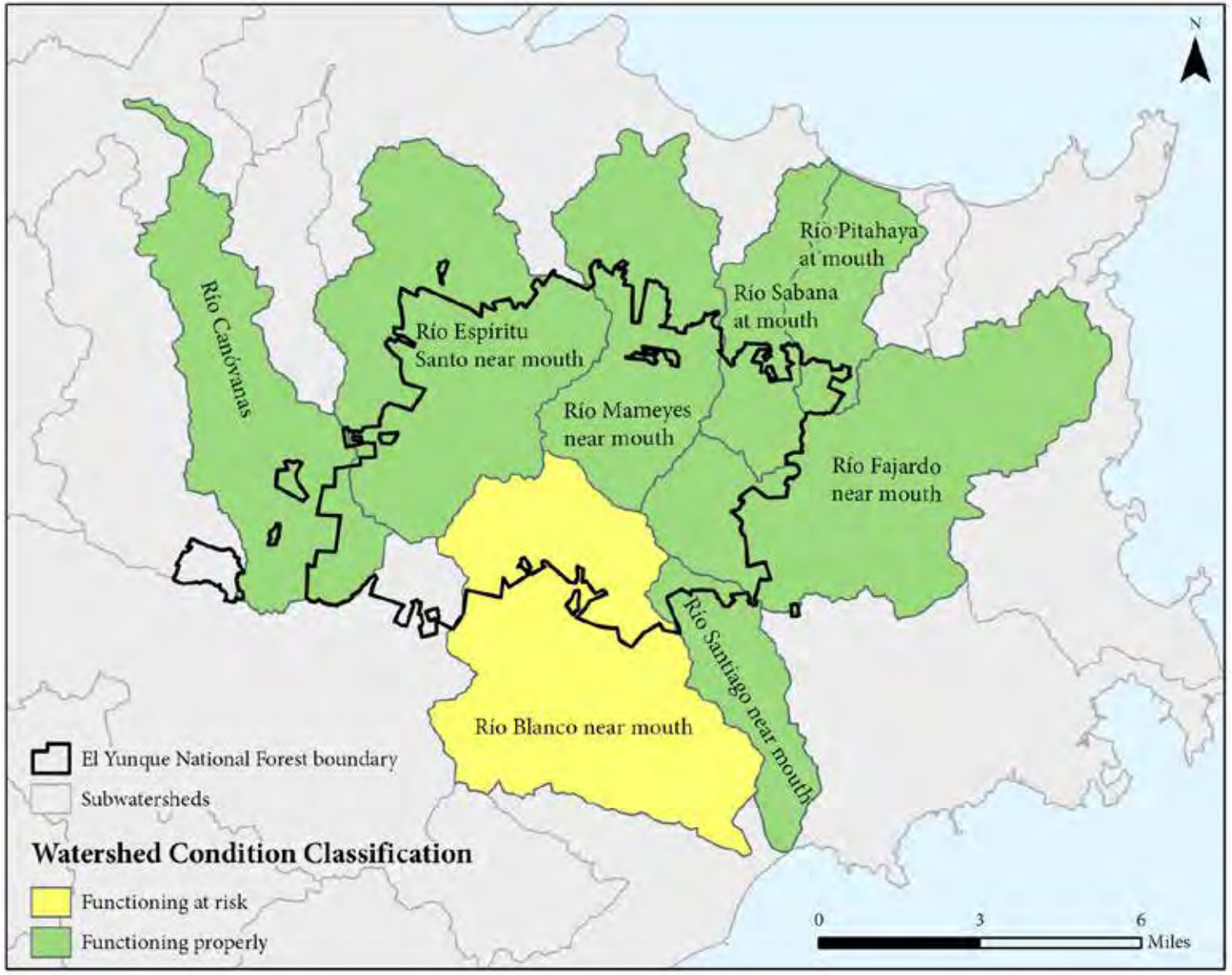
Rivers determined to be not eligible may be managed on El Yunque National Forest under a variety of management areas, geographic zones, and special designations. These prescriptions will allow a wide variety of activities within the river corridor. Management activities may include road construction, vegetation management, insect and disease control, special use utility right-of-ways and mineral extraction. Other management activities that also can affect the river resources to a lesser degree are threatened and endangered species habitat management, recreation and administrative site facility construction and wildlife and fisheries management.

Effects Common to all Alternatives

Under all alternatives, the three eligible wild and scenic rivers would retain their eligibility in accordance with Forest Service manual and handbook direction until they are evaluated for suitability and either designated or released. This means that they would be maintained in their free-flowing condition and their identified ORVs would be retained.

Faced with the challenge of managing the recreation segments of these rivers the Forest would not have the management capacity and resources to pursue additional wild and scenic river designations. All of the streams and rivers that originate in the Forest maintain their free-flowing condition, water quality, and their "outstandingly remarkable values" so in essence they are managed as wild and scenic rivers. River conditions within the Forest were analyzed and determined to be in good state (see El Yunque Plan Assessment 2014).

The analysis of wild and scenic river eligibility was conducted for the previous Forest Planning process (1997) and has been updated to ensure that this could be considered within the public comments. Although the Forest has not requested more designation of wild and scenic rivers.



Map C- 1. Congressionally designated wild and scenic rivers on El Yunque National Forest

Appendix D: Roadless Area and Wilderness

Introduction

This appendix describes the process for identifying and evaluating lands that may be suitable for inclusion in the National Wilderness Preservation System and determining whether to recommend any such lands for wilderness designation. The process occurs in four primary steps: inventory, evaluation, analysis, and recommendation.

Inventory

Areas qualify for placement in inventory if they meet the statutory definition of wilderness. The Forest used the Forest Service Handbook (FSH) 1909.12 Chapter 70 inventory criteria to determine if an area meets the statutory definition of wilderness. The 1997 Plan EIS Roadless Area Evaluation identified two areas as lands that may be suitable for inclusion in the National Wilderness Preservation System, El Toro Roadless Area (12,600 acres) and the Mameyes Roadless Area (11,000 acres). In 2005, El Toro roadless area became El Toro Wilderness Area (10,352 acres).

These two inventoried areas total 23,600 acres out of the total 28,223 acres on the Forest. None of the remaining acres meet the criteria for being included in an inventory of areas that may be suitable for wilderness designation.

The Mameyes Inventoried Area

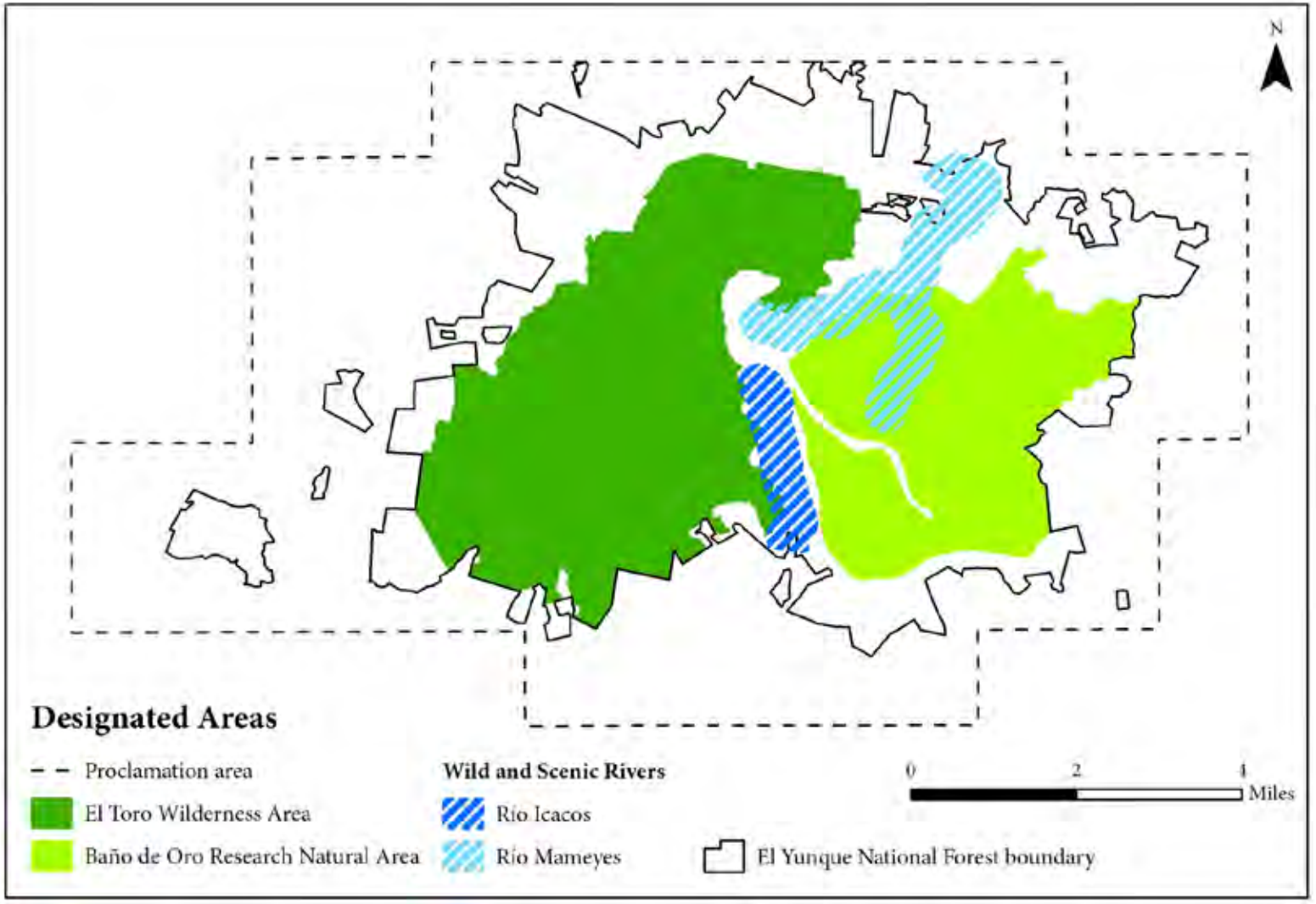
The Mameyes Inventoried Area, located in the eastern half of El Yunque National Forest, is named for the Mameyes River which runs through the west-central portion of the area. It is bounded in the north by the PR Highway 988, on the east and south by the Forest boundary, and on the west by PR Highway 191. It includes 11,000 acres of the National Forest.

The area is accessible by vehicle from PR Highways 191 and 988. It may be entered from the west side by several foot trails and one service road, which branches from PR 191, and on the north side by several trails and two roads which are closed to vehicular use. No trials enter the area from the east or south, where the area is bounded by private land.

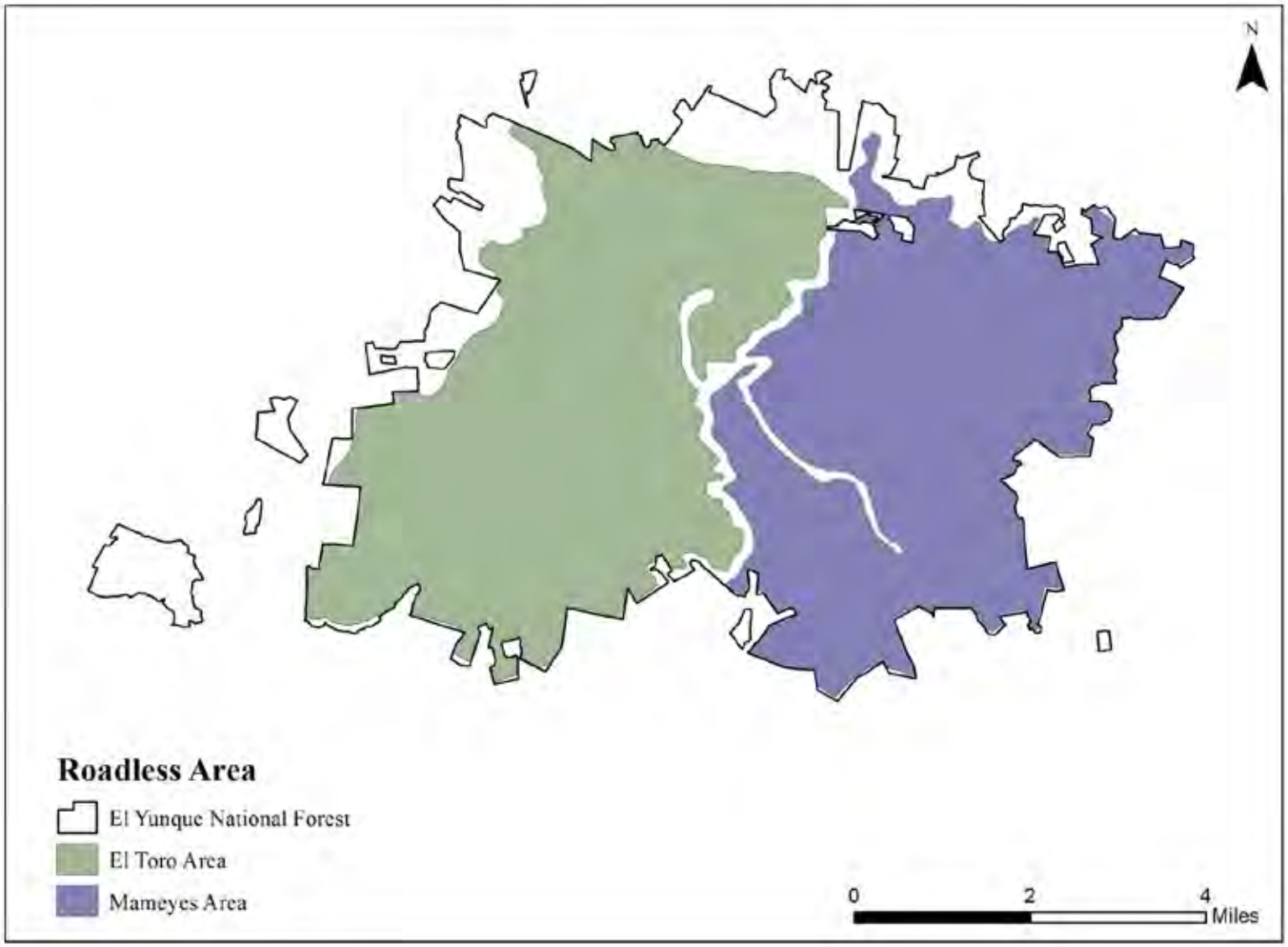
The area lies at Latitude 18 North in an equable maritime climate. The weather is rainy for about 9 months of the year, generally with showers of high intensity.

The area lies on the eastern half of conical Sierra de Luquillo region, with major rivers flowing north, east and south. The slopes in the southern portion are steep to precipitous, and the northern portion includes much land with more moderate slopes. The range in elevation is from 100 meters above sea level where the Mameyes River leaves the Forest, to 1000 meters elevation at Pico del Este (Pico del Este).

The soils are derived from volcanic sediments typically resulting in red clays. The southern portion of the area has sandy soils derived from granodiorite.



Map D- 1. Designated areas, El Yunque National Forest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Roadless Area
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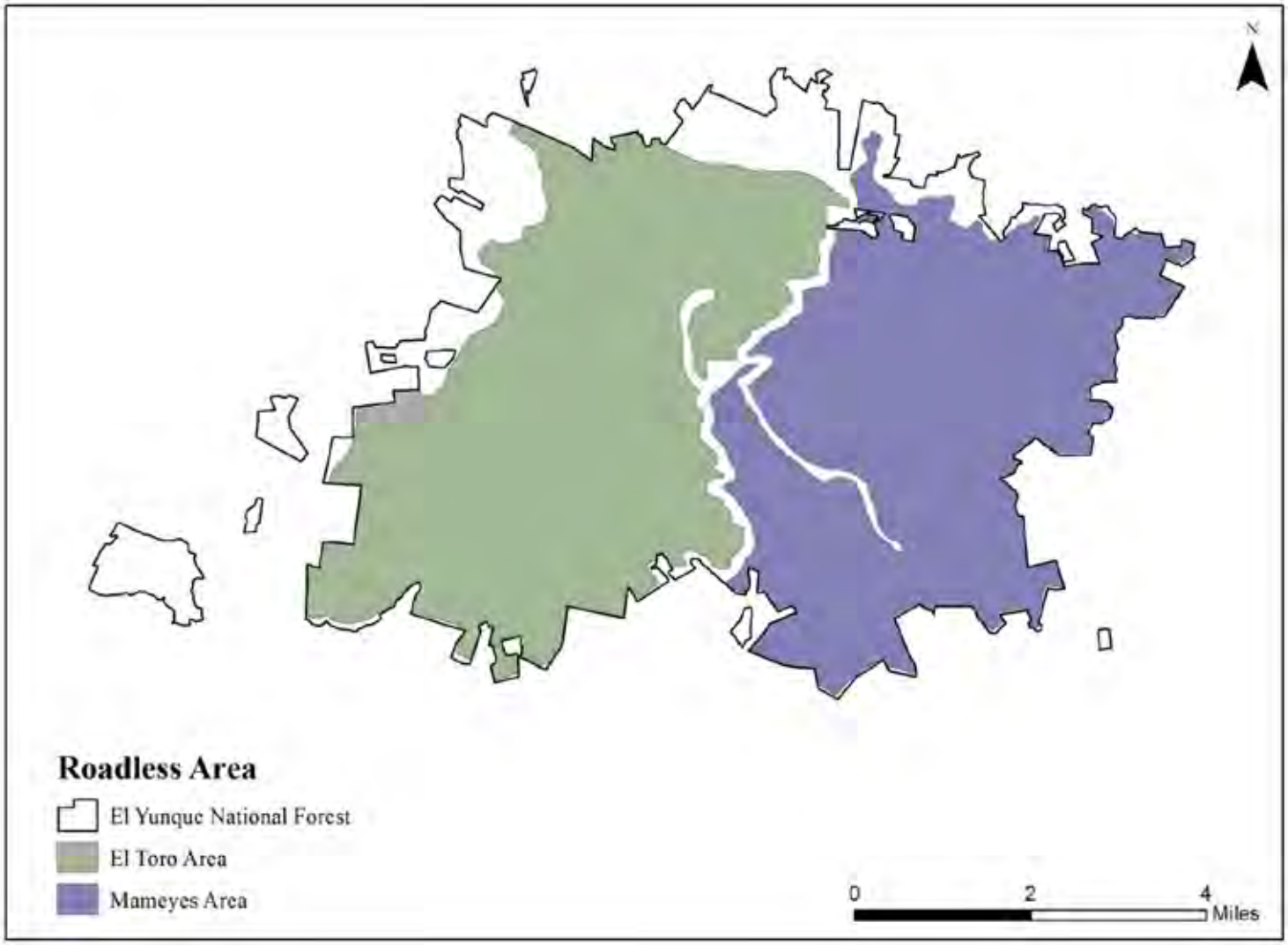

Map D- 2. El Toro and Mameyes inventoried area

Evaluation of the Mameyes Area

Degree to which the area appears to be affected primarily by the forces of nature, with the imprints of man's work substantially unnoticeable.

The vegetation is dense, mix evergreen forest ranging from 3 meters in height on the peaks to 20 meters at lower elevations. Included are Lower Montane and Subtropical Rainforest and Lower Montane and Subtropical Wet Forest life zones, with 12 forest types and 3 riparian zones. In total there are over 200 tree species native to the area. Although most of the area can be considered mature forest, much of the land is secondary forest lands. On these lands timber has been extracted and some lands were clear for agricultural purposes chiefly in the 1800s and the first four decades of the 20th Century. These lands again are forest with some being monocultures of native or invasive tree species. Understory vegetation structure ranges from very dense to fairly open. There are approximately 1,660 acres of mahogany plantations, primarily in the Bisley and Chiquito areas.

Several species of bats are common to the area, but there are no native terrestrial mammals. Feral mongooses, rats, mice and cats are present. The most evident native wildlife are numerous lizard and tree frog species. Species of birds are present, most are year-round residents. Snails, crabs, fresh water shrimp and fish are found in the streams and rivers. Numerous species are endemic to the island.

The peaks in the area offer views of the most extensive uplands in the Forest to the west, the distant coastal lowlands, and the Atlantic Ocean and the Vieques Passage. Seen from above, the Forest is a mosaic of emerald tree colors and tree crown shapes. The major rivers of the area pass over spectacular falls and through canyons.

Old home sites and areas still recovering from farming, lumber, and charcoal logging are evident. Within the depths of the Forest evidence of past modification might escape the untrained eye, but in parts of the area along the western and northern borders the noise of traffic along PR 191 and 988 as over a million visitors drive within the Forest recreation areas. Because of the dense vegetation and steep terrain, it is relatively easy to leave behind the sights, and most of the sounds, of civilization after penetrating only a few hundred meters in the area.

Pico del Este, in the center of the area, and nearby El Yunque Peak have communication towers, which are visible from some of the area, and paved road to this peak (Forest Development Road 27) although excluded from the area almost bisects the area. The vistas towards the Forest to west include several tall tower in the vicinity of El Yunque.

Some of the lands of the Mameyes Area have been managed as part of the then Luquillo Forest Reserve since 1903. Even before that, since 1876 the central portion of this area had been proclaimed a Forest reserve by Spain. To these "Crown lands" many more acres were added to the Forest through acquisition staring in 1931. In 1949 the Secretary of Agriculture designated 2,172 acres within the area as the Baño de Oro Research Natural Area. This portion of the area has since been managed in its natural condition with only non-manipulative research allowed. Prior to acquisition by the Forest Service, some of the northern half was exploited for timber and agriculture.

Degree to which the area has outstanding opportunities for solitude or for a primitive and unconfined type of recreation.

Much of the area is mature forest, especially the central core, and the natural integrity of these areas is very high. Most of the area offers a high degree of solitude to the visitor, because of the denseness of forest vegetation. Portions that border PR 191 on the west side are subject to considerable vehicular noise,

especially from truck and buses in the vicinity of the visitor's information centers. Solitude is highest in the south, east, and central parts of the area.

There currently is a very low level of human activity in the area consisting primarily of research activities and trails hiking.

Excellent opportunities are available to test one's ability and stamina in traversing steep, slippery, forested terrain. Forest travel off the trail is extremely difficult. Disorientation caused by dense vegetation is very common when traveling off the trails. The most remote and challenging areas are in the south, east, and central portions.

There are about 7 miles of trails, all in the northern half. There are very good opportunities for hiking, nature study, and photography in a wilderness environment. Opportunities also exist for swimming in the Mameyes, Fajardo, and Icacos Rivers. Although good access is limited fishing for fresh water shrimp is locally common. Because of the steep terrain and abundant rainfall, good camping opportunities are limited to a few areas during the dry season.

The size of the area is adequate to maintain many of the area's wilderness characteristics, but the shape and some external influences do limit wilderness quality. Pico del Este road, a special-use paved road, penetrates 3 miles in the area where it is only 4 miles wide. In general, the area averages only 3 miles wide, making it susceptible to some external influences, particularly traffic noise on the west and north sides.

Degree to which the area may contain ecological, geological, or other features of scientific, educational, scenic or historic value.

The Forest of the most remote uplands and the area are mature, some of the best examples of mature forests in Puerto Rico. The northern one-third and the southern one-quarter of the area consist of cutover forest and land, which was formerly farmed. Much of the lands has been reforested artificially with mahogany, an introduced species. About 3 miles of stone-surfaced roads penetrate the area from the north. Several water catchments and water pipelines used by municipality and private users occur in the area. They are generally near the boundary, but some penetrate well into the Forest.

The area provides very good formal and informal outdoors education and scientific study opportunities. The core 2,200 acres of the area has been designated as the Baño de Oro Research Natural Area since 1949. In the Central portion of the area, stands of very large, old Palo Colorado trees and large mature Tabonuco trees are common in the research natural area.

Known resources include petroglyphs, mostly on rocks along rivers, and some man-made structures. Opportunities to better discover, protect and interpret cultural resources in the roadless area may be limited due to access restriction under wilderness designation. Actual investigations might be lower under wilderness designation as other areas receive higher priorities for cultural surveys due to other resource management activities.

Degree to which the area may be managed to preserve its wilderness characteristics.

The Mameyes Area boundary is not defined by natural features. It is defined by a series of manmade features, such as already established landlines and paved roads. There are few threats to the wilderness values of the area on the south and east sides, primarily due to the lack of public access to the Forest boundary. Non-wilderness types of activities will continue on adjacent private lands in those areas, but they primarily are small farm, pasture, and private residences with relatively little current effect on

wilderness characteristics. Nevertheless, such development is expected to increase, and with it impacts on the natural character of the area.

The north side of the area also has such influences, but there is public and administrative access as well. There is some non-wilderness activity and influence from vehicles. This access would facilitate administration of potential wilderness. Influences on the west side are primarily from recreational use along PR 191, and in the recreational areas. Activities along this boundary, which effect wilderness values, are noise from vehicles and from visitors using picnic areas and other developed recreation sites.

Within the area there are numerous ridges and streams, which can serve as manageable boundaries between lands of similar elevation. However, there are few good manageable boundaries between the upper elevation and the lower elevations. Best opportunities to enhance wilderness characteristics exist in the south and north portions, where ridges occur in appropriate locations.

The size of the area is adequate to maintain many of the area's wilderness characteristics, but the shape and some external influences do limit wilderness quality. Pico del Este road, a special-use paved road, penetrates three miles in the area where it is only four miles wide. In general the area averages only 3 miles wide, making it susceptible to some external influences, particularly traffic noise on the west and north sides.

Public Input

During the plan revision, community outreach planning meetings were held. During these meetings the participants were informed of the Wilderness Act and that currently the Forest has one federally designated wilderness area, El Toro Wilderness Area. The wilderness designation process was explained during these meetings and at no time was there any interest from the communities or participants in requesting that the Forest pursue designating additional wilderness areas. The public is more interested in having access to more Forest lands to address recreation, environmental education and agroforestry needs.

The demand for wilderness was addressed with the Caribbean National Forest Act of 2005 that designated El Toro Wilderness Area, the only tropical wilderness in the National Forest System. The need to have additional areas designated as wilderness is currently not a priority because of the lack of public interest that has been expressed in pursuing additional wilderness designations.

Analysis

Designation would preclude certain types of wildlife habitat improvement activities that could be designated to increase the number and type of wildlife that use the area including endangered species. Habitats along most of the lowers slopes of the area have been very significantly modified and active programs of tree planting and tree cutting to favor more desirable native tree species for wildlife use have been conducted in the past and continue to be useful in meeting wildlife habitat objectives. Opportunities to establish native plants favorable for wildlife and to accelerate secondary plant succession are desirable to increase habitat productivity and support wildlife populations.

On the upper slopes, which include areas where the Puerto Rican parrot nest, artificial nest structures are provided for parrot use. Constructed blinds for monitoring parrot activities are also used. These types of activities could continue under wilderness designation, but other types of habitat alteration, such as favoring some tree or vine species over other by selective tree thinning or cutting, would not be compatible with designation. However, at this time it is not foreseen that such habitat alterations will be needed to recover the parrot.

About one-third of the land within the area was acquired by the Forest Service under the Weeks Law, for producing timber and for watershed protection. Management of these acquired lands during the subsequent 50 years had been directed toward timber production. About 1,600 acres of lands in this area have been managed for timber production and other uses. The timber volume of this area has been inventoried in 1937, 1948, and 1968. Below 2,000 feet elevation, mature trees had been harvested selectively in the past on thousands of acres; immature stands were liberated and thinned repeatedly. Lands that had been deforested prior to purchase were planted with timber tree species, some pure and others intermixed with native tree species.

A prototype rural industry, using artisans and craftsmen to manufacture saleable articles from timber species, is being considered. Wilderness designation of these lands, which are highly capable of providing wood products on a sustained level, would preclude these acres from being used to help contribute to the high demand for these local wood products.

The National Forest was formally designated the Luquillo Experimental Forest because the complex nature of the Forest required an integrated research program. Scientists have located "representative areas" within the Forest to conduct studies. Two general approaches have been planned and followed to date in order to provide Forest managers with important, necessary information: basic studies to determine how ecosystems function, and applied studies of silvicultural treatments to enhance ecosystem stability, sustainable production of timber, wildlife habitat, water and other Forest resource. Several basic study sites are located in the Mameyes inventoried area. An example is the Baño de Oro Research Natural Area, where research monitoring has been in progress since 1946.

In several areas both basic and applied studies have been done, are continuing, or could be done. One is the 540-acre watershed of the upper Rio Sabana and Rio Camandulas, the only entire watershed in the mature Tabonuco forest. In the Mameyes Valley are three small watersheds (45 acres) already under calibration for studies of the impact of timber harvesting on soil and water resources. North of Pico del Este is a 200 comparative studies of this type of forest are possible, since the rest is within the research natural area, not available for manipulation. The 820-acre east side of the Rio Icacos Valley is the only lower montane wet forest available for comparative research.

The possibility of conducting selective vegetation treatments in some of these areas would be precluded by wilderness designation, and access for researchers to areas like Baño de Oro Research Natural Area to conduct non-manipulative research activities would be significantly hindered because the Bisley Road could not be used or possibly extended for vehicular access.

Although wilderness designation would make this area unavailable for many of the above uses, non-designation would not automatically result in significantly reduction or degradation of the wilderness attributes of the area. Under a non-wilderness designation, it is expected that several activities would occur on some acres including water and recreation developments, and timber management demonstration treatments and manipulative research treatments, both in secondary forest. Such treatments would require the use of some motorized equipment on well establish secondary roads within the inventoried area.

Under direction currently being considered the maximum number of acres that could be treated during the next 10 years is less than 200 acres over the entire Forest, with the best areas located within the inventoried area. Such uses would interrupt some naturally occurring processes (such as secondary succession), and temporarily reduce the level of solitude and challenge in areas where such activities took place.

Several water catchment and transmission lines provide water and power to private landowners adjacent to the Forest. Water from two-thirds of the area currently enters municipal supply systems, including

Luquillo, Fajardo, Humacao, Vieques and during emergencies, San Juan. A major transmission pipeline takes water from Rio Cristal to supply the entire town of Luquillo. A public hydroelectric plant operates with the waters of Rios Prieto and Icacos, which drain the southern slopes of the area. Although these uses and improvement are not incompatible with current wilderness management direction, more facilities for water diversion can be expected to be needed and proposed in the future.

The entire Forest also is a Biosphere Reserve, an internationally designated protected area managed to demonstrate the value of conservation. Management of lands within Biosphere Reserves can range from intense human use, including exploitation and site modification, to complete protection from non-natural modifications a management strategy identical to that of wilderness.

Opportunities exist to developed recreation facilities on some sites, which would help meet current and project demand. These include developing water, sanitary facilities, and picnic and/or campsites along Rio Chiquito and Rio Mameyes. The Forest currently is the second most visited tourist site in Puerto Rico, and half of the demand for recreation use is for developed recreation. Current demand is not being met with existing facilities.

It also needs to be considered that only about 1 percent of the land surface of the Island is unmodified, and no unmodified tracts larger than those in the Forest exist elsewhere. Moreover, other than the companion El Toro Wilderness Area, there are no other declared or prospective wilderness areas readily available to the millions of citizens in Puerto Rico. Although, El Toro Wilderness Area is over one-third of El Yunque National Forest's acreage.

El Toro Wilderness within El Yunque is the only tropical forest wilderness within the National Forest System and the only within the U.S. Wildlife species such as the broad-winged hawk and the Puerto Rican parrot also depend to a certain extent on the undisturbed habitat.

The present demand for wilderness visitation is low considering the large number of people that visit the Forest. Lack of prior exposure to the interested users and the absence of an existing established concept of wilderness values in the general population are likely the main reasons for this lack of interest. When communicating with the public to explain this concept; acceptance of wilderness was vast; but no further desired designation was requested or desired.

The 11,000 acre Mameyes Area from the inventory compared to the 6,441-acre Inventoried Roadless Area

The Mameyes Inventory Area contains 11,000 acres. The area includes the Baño de Oro Research Natural Area (6,441 acres) as well as lands surrounding the research natural area (11,000 acres - 6,441 acres = 4,559 acres). The inventoried roadless area is the same as the research natural area and this is the area that is proposed for wilderness in alternative 3. The remaining 4,559 acres in the Mameyes Area were not recommended for wilderness in alternative 3 because they include another area set aside for research, but where the research activities would not be compatible with wilderness designation. For the other remaining acres, it was determined that these lands could provide better opportunities for meeting local community needs by placing them in the Community Interface Resource Management Area.

Table D- 1. Summary of proposed wilderness by alternative[1]

Existing Area	Alternative 1 1997 Plan	Alternative 2 Proposed Action	Alternative 3
El Toro Wilderness (acres)	10,363	10,352[1]	10,352
Inventoried Roadless Area (acres)	6,441	6,441	-
Proposed Additional Wilderness (Baño de Oro) (acres)	0	0	6,441

1 New acreage based on GIS Delineation process.

Appendix E: Puerto Rico Land Use Plans and Policy

The Forest reviewed various Planning and Land Use Policies for the eastern part of Puerto Rico. The forest also established comunication with the Puerto Rico Planning Board (PRPB) to ensure compatability and to work collaboratively on land use which could assist conservation efforts on the Island. This information was first documented within the Forest Plan Assessment in order to have a comprehensive understanding of the region's current condition in terms of land use. The forest detailed the history of land use, current land use policies and the current land use plans. All that served as the base line for the planning process when considering land use within forest boundaries and at a broad-landscape level. The forest also considered land uses at the local level when developing proposed actions such as:

- Provide updated guidance for managing the Forest within the context of the larger landscape and for addressing local land use changes and the associated impacts on the Forest. For example, developing management strategies for partnership opportunities, collaborative efforts, and coalitions of support to promote sustainability and to solve existing and future challenges at the landscape level.
- Collaborate with the Municipalities' Territorial Plan and Puerto Rico Land Use Plans by fostering an All Lands Regional perspective.
- Create a land acquisition plan that promotes conservation initiatives for protection of surrounding hills, stream corridors, riparian zones, Wild and Scenic River corridors, and connections to the Northeast Reserve.

The compatibilities between land use plans and conservation, water use, recreation, and other uses were considered when developing the forest plan. Finally, the forest used information from municipal land use plans and commonwealth land use plans to express the current condition of the lands in the region when developing effects analysis in the Environmental Impact Statement. Both the Revised Forest Plan and the Environmental Impact Statement considered the local land use policies and land use plans to ensure compatibility.

The Forest used the following Land Use Plans and Commonwealth Land Use Policies:

- Puerto Rico Department of Natural and Environmental Resources, Comprehensive Wildlife Resources Assessment
- Puerto Rico Department of Natural and Environmental Resources, Forest Resources State-wide Assessment
- Puerto Rico Planning Board Land Use Plan
- Municipality Territorial Order Plans
- Puerto Rico Department of Natural and Environmental Resources Water Plan

The land use plans for municipalities that were considered include:

Municipality	Applicable Land Use Plans	Applicable Land Use and Zoning Regulations
Canóvanas	Municipal Land Use Plan (2000) PRPB Region 9 Land Use Plan (draft 2012)	Municipal Land Use Regulation (2000) PRPB Joint Regulation (2010)
Río Grande	Municipal Land Use Plan (2012) PRPB Region 11 Land Use Plan (draft 2012)	PRPB Joint Regulation (2010)
Luquillo	No municipal land use plan Zoning established through El Yunque Special Zoning Regulation (1983/1996) Special Plan for the Gran Reserva Natural Special Planning Area (2011) PRPB Region 11 Land Use Plan (draft 2012)	PRPB Joint Regulation (2010) Special Regulation for the Gran Reserva Natural Special Planning Area (2011)
Fajardo	Municipal Land Use Plan (2010) PRPB Region 11 Land Use Plan (draft 2012)	PRPB Joint Regulation (2010)
Ceiba	No Municipal Land Use Plan Zoning established through El Yunque Special Zoning Regulation (1983/1996) Master Plan for the Former Roosevelt Roads Naval Base (2011) PRPB Region 11 Land Use Plan (draft 2012)	PRPB Joint Regulation (2010)
Naguabo	No municipal land use plan Zoning established through El Yunque Special Zoning Regulation (1983/1996) PRPB Region 11 Land Use Plan (draft 2012)	PRPB Joint Regulation (2010)
Las Piedras	No municipal land use plan Zoning established through El Yunque Special Zoning Regulation (1983/1996) PRPB Region 10 Land Use Plan (draft 2012)	PRPB Joint Regulation (2010)
Juncos	Municipal Land Use Plan (2007) PRPB Region 10 Land Use Plan (draft 2012)	PRPB Joint Regulation (2010)

Municipal Land Use Laws and Regulations

It was necessary to consider that in Puerto Rico, decentralization through regionalization and shifting of powers to municipalities is "recommended to respond faster and more efficiently to the challenges of sustainability as it is being done in other parts of the world and suggested by the United Nations" (CSDS 2009). Regionalization, by virtue of public policy, should emphasize cooperation and shared responsibilities for those social, economic and environmental activities that are more regional in scope and impact (CSDS 2009).

The Autonomous Municipalities Act (Law 81 of 1991, as amended) provided for a gradual decentralization process in land use planning in Puerto Rico, allowing municipalities to determine land uses within their jurisdictions, subject to a series of procedural and substantive conditions. This law enabled municipalities to prepare municipal land use plans (Plan de Ordenación Territorial), to be adopted by the PRPB and approved by the governor, and to assume the task of regulating land use within their

boundaries. Nevertheless, without a comprehensive Island-wide land use plan or framework, municipal governments have lacked crucial information necessary to navigate the land use planning process, which would have provided direction and coherence to all municipal land use plans. If approved, the regional land use plans should provide this guidance and direction. Within El Yunque Region, four municipalities had approved municipal land use plans as of October 2012 (i.e., Canovanas, Fajardo, Juncos, and Rio Grande). At that time, Luquillo, Naguabo and Las Piedras were in the final stages of development, while Ceiba was in the early stages of development of its municipal land use plan. All land use planning and zoning regulations that apply in El Yunque Region are summarized in the Forest Plan Assessment (2014).

Land Use and Land Ownership in El Yunque Region

El Yunque National Forest land ownership has remained stable in recent years, though priority acquisition areas remain largely unprotected on private lands. Total El Yunque National Forest acreage has held at approximately 29,000 acres for many years, consisting of one large block of forest and several small isolated parcels. Several parcels of land were identified in the 1997 Land Management Plan as priority acquisition areas for the consolidation of the Forest, protection of wildlife, expansion of recreational opportunities, among other purposes. However, very few of these have been obtained through the National Forest or its partners, nor have they been submitted to formal conservation programs by private landowners, essentially leaving them open to possible degradation or conversion.

El Yunque National Forest has several designated land uses, which contribute to forest conservation and socio-ecological sustainability. Special designated land uses within El Yunque National Forest include the federally-designated experimental forest, a research natural area, wild and scenic river segments, and a wilderness area. The Forest, in its entirety, also is internationally recognized as a UNESCO Biosphere Reserve. Finally, the Forest is recognized by the government of Puerto Rico as a priority conservation area, having a scenic byway and a critical wildlife area.

El Yunque National Forest encompasses over 30 miles of roads and 36 miles of trails, but given its popularity, there is frequent congestion and overcrowding of the Forest during high use times. More than 30 miles of roads transect the Forest, though vehicular access is limited to a single point of entry at the intersection of PR 191 and PR 9966. Within the boundaries of El Yunque National Forest, there are 24 miles of recreational trails and 12 miles of administrative trails, which are restricted to foot traffic only. Given the heavy concentration of recreation opportunities along PR 191, there is a tendency toward overcrowding of recreation sites and parking areas.

El Yunque National Forest region spans nine municipalities in eastern Puerto Rico, stretching over 29,000 acres, encompassing about 15 percent of their total area. The nine municipalities that comprise El Yunque Region total more than 220,000 acres (347 square miles), which is about 10 percent of the Island's total area.

Forested areas represent the largest portion of land cover in the region surrounding El Yunque National Forest, and forested cover has increased over the past several decades. Nonetheless, urban cover is increasing at a much more rapid pace, resulting in landscape fragmentation and negative impacts on the Forest and other natural areas in the Region. Forested areas account for 43 percent of El Yunque Region; followed by pasture (including agricultural lands), 36 percent; and urban areas (10 percent). Inconsistent land use planning and enforcement have resulted in haphazard urban expansion in the region, as across the Island, oftentimes in areas not suitable for urban development. Urban and built-up areas lead to landscape fragmentation or removal of forested lands, which in turn affect ecosystem structure and function and the services provided by forests within and around El Yunque National Forest.

Land dedicated to farms in the region surrounding El Yunque National Forest is decreasing, while also being increasingly "parcelized" and fragmented. Farmland is important for the production of food and the preservation of open space, scenic vistas, and wildlife habitat, but these areas are increasingly susceptible to urban development and other macro- and socio- economic forces. Between 2002 and 2007, the land area covered by farms decreased in El Yunque Region; however, the number of farms itself increased (from 628 to 834 farms). While some of the fluctuation in farm numbers likely comes from small operations that enter and exit agricultural activity in response to fluctuations in the marketplace, much of the change in the number and area of farms is an indication of the "parcelization," conversion, and ultimate fragmentation of larger agricultural landholdings within El Yunque Region.

Puerto Rico Land Use and El Yunque's Planning Process

When analyzing the current condition of the use of the surrounding lands, the forest developed a Revised Plan and its Environmental Impact Statement that is compatible and considers the broader-landscape perspective in its management decisions.

Desired conditions, objectives, goals, standards and management strategies in the revised plan promote an "all-lands approach," which encourages working with local governments to achieve common goals and maximizes resources. The revised plan recognizes the importance of its surrounding communities and stakeholders as well as the opportunities to improve the quality of life for people living within the area adjacent to the national forest. Quality of life is affected by adequate access, sustainable economic opportunities, sustainable recreation, and ecological sustainable practices. Some coordination needs identified in the Revised Forest Plan include the following statements:

- Create a collaborative process with local partners from the surrounding municipalities to develop conservation projects that extend beyond the forest. (FEIS, Chapter 2, "Comparisons among Alternatives 1, 2 and 3" section).
- Work with private land owners to consider conservation iniatives that could both benefit them and increase forest resource protection through programs such as conservation easements and other land conservation and restoration programs. (Revised Plan, Chapter 3, Social and Economic Sustainability and Multiple Use).
- This decision, through the revised land management plan, creates opportunities for interconnected trail systems through partnerships with local, State and Federal agencies and nonprofit organizations (Revised Plan, Chapter 3 Social and Economic Sustainability and Multiple Use).
- Acquisition of lands to ensure the protection and connection of riparian zones with forest river corridors and the acquisition of abandoned agricultural lands, are identified as a priority. Such acquisition will only occur when there are willing sellers (Revised Plan, Chapter 3 Social and Economic Sustainability and Multiple Use).
- Provide assistance or education to agricultural landowners in the region surrounding El Yunque to help them understand that agricultural lands also represent an opportunity for conservation, for providing habitat for wildlife, and providing employment through recreation. (Revised Plan, Chapter 3 Social and Economic Sustainability and Multiple Use).

The forest concluded that the approach for an all-lands perspective should be collaborative in terms of coordinating with State and municipal land use plans. This effort will improve the possibilities for the sustainable management of forest lands throughout the region.

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